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COST OF USING HORSES, TRACTORS AND COMBINES ON WHEAT FARMS IN SHERMAN COUNTY, OREG.[1]

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CONTENTS

Shortage of farm labor and the higher cost of keeping work stock were factors in the greater use of tractors on wheat farms in Sherman County, Oreg., during and immediately following the World War. The number and size of combines also increased materially. The term " combine," as used in this bulletin, refers to the combined harvester-thresher.

The purpose of this study is to show what present owners and prospective purchasers of combines and tractors can reasonably expect in the way of costs of using combines, horses, and tractors, and to present some of the important points which should be considered

[1] Acknowledgment is due to R. V. Gunn, formerly farm management demonstrator, Oregon Agricultural College Extension Service; Clair Wilkes, Oregon Agricultural College, and P. C. Newman, Bureau of Agricultural Economics, U. S. Department of Agriculture, for valuable assistance in collecting the field data presented in this bulletin. Thanks are extended to the many farmers through whose courtesies the securing of the field data was made possible.

in the selection of combines and the choice of motive power in a region of relatively large grain farms.

Data on which this bulletin is based were obtained by personal interviews with actual farm operators during a study of the cost of winter wheat production and farm organization for the calendar years 1920, 1921, and 1922.

AREA AND EXTENT OF STUDY

Sherman County, Oreg., is located in an upland area of the southwestern portion of the Columbia River basin in a region of very limited rainfall. The average annual precipitation at Moro in Sherman County is about 11.5 inches. Practically all of the rainfall occurs during the period from September to June, inclusive. The soil varies from a sandy loam to a silt loam type and is free from loose surface stones. The topography ranges in character from nearly level areas to very rolling slopes and is broken by canyons, the more rugged portions of which are used principally for grazing purposes. Dry-farming methods are well established. The prevailing farm practice is to clean-cultivate the land one year and follow with a crop of grain the succeeding year.

Winter wheat production is the chief enterprise. Over the period 1920 to 1922, on tractor-owned farms, the average total acreage per farm was divided approximately 39 per cent to wheat, 3 per cent to other crops, 42 per cent to summer fallow and 16 per cent to pasture and waste land. On nontractor farms the approximate division of the farm area was: Wheat, 34 per cent; other crops, 5 per cent; summer fallow, 37 per cent; and pasture and waste land, 24 per cent. The crops other than wheat were oats and barley which were utilized mainly as feed for livestock. The number of farms studied, distribution of the farm area, numbers of work stock and colts per farm, and total number of tractors and combines on these farms are given in Table 1.

TABLE 1.—*Number of farms studied, distribution of farm area, numbers of work stock and colts per farm; total tractors and combines on these farms, 1920–1922*

Item	1920		1921		1922		3-year average	
	Tractor	Nontractor	Tractor	Nontractor	Tractor	Nontractor	Tractor	Nontractor
Farms—number	37	108	39	114	35	117	37	113
Size of farm—acres	1,237	904	1,388	900	1,459	945	1,360	917
Area under cultivation per farm:								
Wheat—do	484	315	516	312	587	325	528	317
Other crops—do	33	41	46	46	54	45	44	44
Summer fallow—do	529	326	592	337	582	357	568	341
Total	1,046	682	1,154	695	1,223	727	1,140	702
Pasture per farm—acres	171	205	214	190	217	204	201	200
Waste land per farm—do	20	17	20	15	19	14	19	15
Work stock per farm—number	13.6	16.3	15.0	17.1	15.2	17.9	14.6	17.1
Colts per farm—do	4.0	4.5	3.7	4.4	3.5	3.6	3.8	4.1
Tractors—do	42	0	45	0	40	0	42	0
Combines—do	31	68	32	76	27	76	30	73

A total of 450 records were obtained over the three-year period, 1920 to 1922. Approximately the same number of farms were visited each year. Tractors were owned on about one-fourth of the farms.

The average acreage per farm was considerably larger on farms where tractors were owned, but the type of farming was similar and the division of the acreage as between grain crops, summer fallow, pasture, and waste land was in about the same proportion on both tractor and nontractor farms. Some tractor work was hired on 8 nontractor farms in 1920; on 7 nontractor farms in 1921; and on 14 nontractor farms in 1922. More than one tractor per farm was owned on 4 farms in 1920 and 1922, and on 5 farms in 1921.

During the three years, a total of 310 records were obtained on the cost and operation of combines. Combines were owned on 81 per cent of the tractor farms, and on 65 per cent of the nontractor farms. Over this period, the work of combine harvesting on 8 per cent of the tractor farms, and on 19 per cent of the nontractor farms, was either all or partially hired. On only one farm was more than one combine owned. The harvesting and threshing work was all, or partially, done with the header and stationary thresher on 6 per cent of the tractor farms, and on 10 per cent of the nontractor farms.

The number of work stock on tractor farms in 1920 and 1922 averaged 2.7 less per farm, and in 1921, about 2 less per farm than on nontractor farms. During this time, on tractor farms, the number of colts to the number of work stock was in the proportion of about 1 to 3.8. On nontractor farms the ratio was about 1 to 4.2. Colts were found on 70 per cent of the tractor farms and on 78 per cent of the nontractor farms. On tractor farms the number of farmers owning no colts to the number owning colts was in the ratio of 1 to 2.4. On nontractor farms the ratio was 1 to 3.5.

The number of tractor and nontractor farms included in the tables which follow depend upon the data to be shown. Certain farms have been omitted from some of the tables because of incomplete data or other irregularities which render them incomparable with other farms included in the study.

SIZE OF TRACTORS

Because of the large tractors capable of drawing several plows and which, in some instances, did not draw a full load, tractors have been classified on a drawbar horsepower basis, instead of on the basis of number of plows drawn. Tractors that were not used for some drawbar work were not included in these tabulations. A majority of all tractors except the 10-horsepower size, were of the crawler type and were of the larger, heavier sizes. The sizes of tractors used are shown in Table 2.

TABLE 2.—*Size of tractors, 1920–1922*

Size (drawbar horsepower rating)	Tractors			Percentage of total tractors		
	1920	1921	1922	1920	1921	1922
	Number	*Number*	*Number*	*Per cent*	*Per cent*	*Per cent*
10	9	10	6	21	22	15
20	5	6	6	12	13	15
28	4	3	3	10	7	7
40	15	15	15	36	33	38
50	9	11	10	21	25	25
Total	42	45	40	100	100	100

KINDS AND AMOUNTS OF TRACTOR WORK PER FARM

Kinds and amounts of work per farm performed by tractors in 1922 are shown in Tables 3 and 4. There was considerable variation in the total number of days of annual tractor work, depending somewhat on the size of farm and size of tractor. The variation in days of annual use per tractor was from 7.4 to 115.7. The average was fifty and eight-tenths 10-hour days per farm.

TABLE 3.—*Kinds and amounts of tractor work per farm on 31 tractor farms 1922* [1]

Kind of work	Farms reporting	Man days per farm [2]	Tractor days per farm [2]	Percentage of total tractor days
Drawbar work—home:				
Plowing—	*Number*	*Number*	*Number*	*Per cent*
Spring	27	29.4	23.3	45.9
Fall	0	0	0	0
Harrowing—				
Spike	4	1.4	1.4	2.7
Spring	3	.4	.4	.8
Disking before plowing	16	4.4	3.7	7.3
Other disking	3	.3	.3	.6
Weeding	2	.6	.6	1.2
Drilling	6	2.9	1.5	2.9
Harvesting and threshing with combine	21	65.3	13.6	26.8
Miscellaneous	11	.8	.8	1.6
Total	31	105.5	45.6	89.8
Drawbar work—custom:				
Plowing	4	1.6	1.6	3.1
Harrowing	1	.4	.4	.8
Harvesting and threshing with combine	11	13.5	2.8	5.5
Road work	1	.1	.1	.2
Total	15	15.6	4.9	9.6
Belt work—home:				
Feed grinding	1	.5	.3	.6
Total work—home	31	106.0	45.9	90.4
Total work—custom	15	15.6	4.9	9.6
Total all work	31	121.6	50.8	100.0

[1] Farms on which more than one tractor was owned or on which there was an excessive amount of contract horse or tractor work have been omitted from this table as well as from Tables 4, 5, and 6.
[2] Averages for total number (31) tractor farms.

TABLE 4.—*Various drawbar operations and proportion done with horses and with tractors on 31 tractor farms, 1922* [1]

Kind of work	Work per farm done with [2]—		Percentage of total work done with—	
	Tractors	Horses	Tractors	Horses
Plowing:	*Acres*	*Acres*	*Per cent*	*Per cent*
Spring	421	132	76	24
Fall	[3]	1	[3]	100
Harrowing:				
Spike	116	1,214	9	91
Spring	17	23	43	57
Disking before plowing	209	12	95	5
Other disking	12	5	71	29
Weeding	47	474	9	91
Drilling	106	462	19	81
Harvesting and threshing with combine	446	87	84	16

[1] Averages for the total number (31) tractor farms.
[2] For such operations as harrowing, disking, and weeding, the acres of work done are figured on the basis of once over the ground; that is, if a 50-acre field was disked twice, the total acres covered are 100 acres.

HOME DRAWBAR WORK

Twenty-seven of the thirty-one tractor owners reported the use of the tractor for spring plowing, which amounted to 45.9 per cent of the total days of tractor work per farm (Table 3). On 16 farms all of the plowing was with tractor-drawn plows. On these 31 tractor farms, an average of 553 acres per farm was spring plowed, of which 421 acres were plowed with tractor-drawn plows (Table 4). Practically all of this plowing was in the preparation of land for summer fallow. Large equipment was used. Usually the outfits pulled packers behind the plows (fig. 1). A common size of plow for use with 10-horsepower tractors consisted of two 14-inch bottoms; for 20-horsepower tractors, four 14-inch bottoms; for 28-horsepower tractors, six 14-inch bottoms; for 40-horsepower tractors, six 16-inch bottoms; and for 50-horsepower tractors, nine 16-inch bottoms. The outfits usually required a man to manage the plows in addition to the tractor operator. The man days for a total of 23.3 tractor days of plowing was 29.4 per farm.

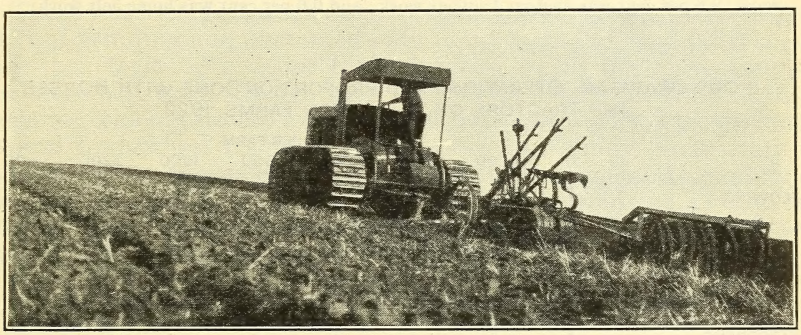

FIG. 1.—Spring plowing in preparation of land for summer fallow. Tractor of the 40-drawbar horsepower size hauling six 16-inch plow bottoms with a packer attached behind. Seventy-six per cent of spring-plowed acreage was done with tractor-drawn plows and approximately one-third of the tractors owned on these farms were of the 40-horsepower size

Four men reported the use of the tractor for spike-tooth harrowing, and three for spring-tooth harrowing. On the average, spike and spring-tooth harrowing represented 3.5 per cent of the total days of tractor work per farm.

Disking before plowing with tractor-drawn disks was reported by 16 men. The total disking before plowing amounted to an average of 221 acres per farm, of which 95 per cent was with tractor-drawn disks. The common size of implement for this operation with 10-horsepower tractors was one 8-foot disk; for 20-horsepower tractors, two 8-foot disks; for 28 and 40 horsepower tractors, three 8-foot disks; and for 50-horsepower tractors, four 8-foot disks. Three men used a two-man crew. The average tractor days per farm for this operation was 3.7 and the average amount of man labor was 4.4 days. Disking before plowing constituted 7.3 per cent of the total tractor days per farm. Other disking was reported by only three men. One disked plowed ground and two disked stubble land which was seeded without further preparation.

Weeding with tractor power was reported on only two farms where 30 and 36 foot weeders were used.

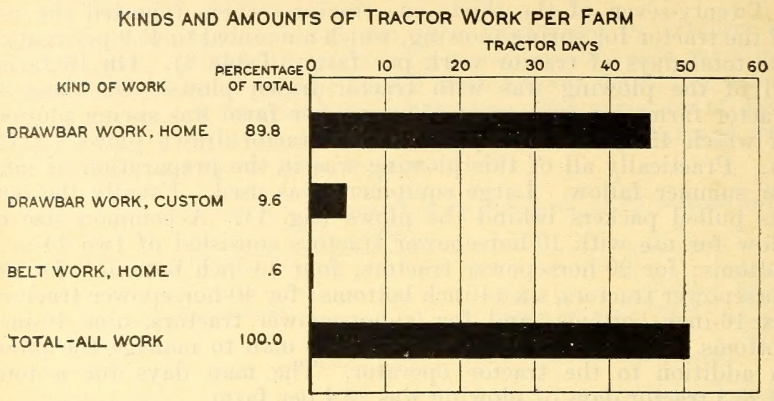

FIG. 2.—Of the total days of tractor work 89.8 per cent consisted of home drawbar work; 9.6 per cent was custom drawbar work; and 0.6 per cent was home belt work

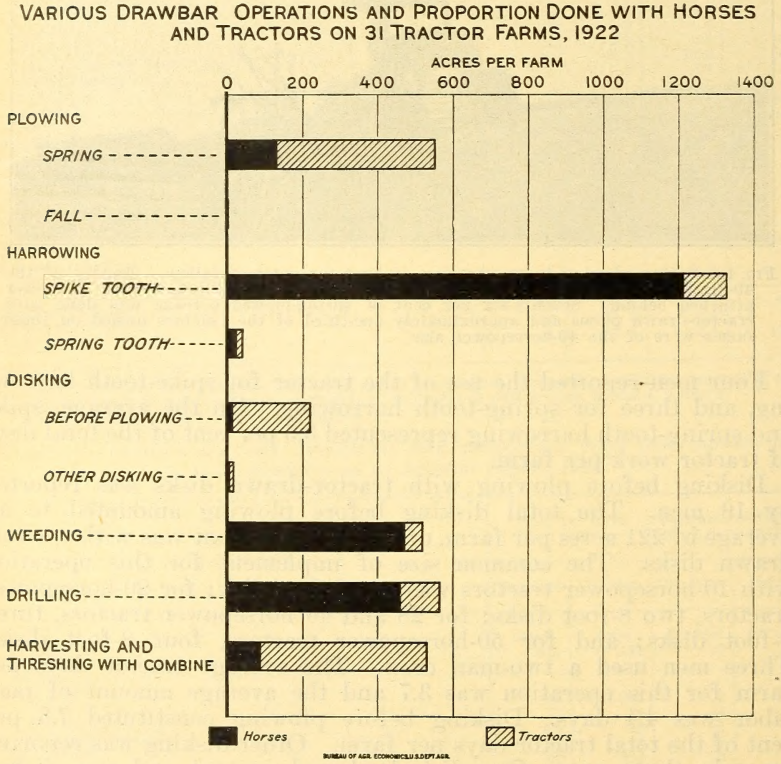

FIG. 3.—The principal drawbar operations done with tractors were spring plowing, disking before plowing, and harvesting and threshing with combine. The most common operations done with horses were spike-tooth harrowing, weeding, and drilling

Drilling with tractor-drawn drills was reported by six men. This work amounted to an average of 106 acres, or to 2.9 per cent of the total tractor days per farm. Only one man used his tractor for all of his drilling. A two-man crew was used on all tractor-drawn drills.

Harvesting and threshing with tractor-drawn combines was reported by 21 of the 31 men. Various sizes of combines were used, depending mainly upon size of farm and size of tractor owned. In all, 13.6 tractor days or 26.8 per cent of the total tractor work per farm was represented by harvesting and threshing with the combine. The man labor for this operation amounted to a total of 65.3 days per farm.

Eleven men reported miscellaneous work such as moving buildings, and moving the tractor from one job to another, which amounted to less than one tractor day per farm.

HOME BELT WORK

There was little belt work done by the tractor. It consisted entirely of feed grinding and amounted only to 0.5 man-days and 0.3 tractor-days per farm. No doubt these farmers would use their tractors for more belt work if there were more to be done. No tractors were included which were not used for some drawbar work. This excluded several high-wheel tractors, which were used almost exclusively to provide power for stationary threshing. The kinds and amounts of the various classes of tractor work and the proportion of the important drawbar operations done by horses and tractors are shown graphically in Figures 2 and 3.

KINDS AND AMOUNTS OF HORSE WORK PER FARM

TABLE 5.—*Kinds and amounts of horse work per farm, 31 tractor farms, 1922* [1]—

Kind of work	Farms reporting	Man days per farm	Horse days per farm	Percentage of total horse days per farm
	Number	*Number*	*Number*	*Per cent*
Spring plowing	16	17.5	158.0	18.0
Fall plowing	2	.2	1.4	.2
Total plowing	16	17.7	159.4	18.2
Disking before plowing	2	.6	6.8	.8
Other disking	6	.3	1.9	.2
Harrowing, spike tooth	31	27.7	197.4	22.5
Harrowing, spring tooth	1	1.2	7.3	.8
Rolling	3	.5	2.8	.3
Weeding	25	19.7	122.2	13.9
Total land preparation other than plowing	31	50.0	338.4	38.5
Drilling	30	20.8	104.4	11.9
Harvesting and threshing with combine	8	16.5	67.C	7.6
Harvesting and threshing with header and stationary thresher	2	6.9	11.2	1.3
Total harvesting and threshing grain crops	10	23.4	78.2	8.9

[1] This table does not include a limited amount of miscellaneous horse work such as mowing weeds, repairing fences, road hauling of feed for livestock, etc.

TABLE 5.—*Kinds and amounts of horse work per farm, 31 tractor farms, 1922*—Continued

Kind of work	Farms reporting	Man days per farm	Horse days per farm	Percentage of total horse days per farm
Haying work:	*Number*	*Number*	*Number*	*Per cent*
Cutting, reaper	12	1.4	2.8	0.3
Cutting, header	11	.9	5.5	.6
Cutting, binder	5	.5	1.7	.2
Cutting, mower	4	.6	1.2	.1
Raking hay	4	.4	.7	.1
Hauling hay	31	13.8	23.3	2.7
Total haying work	31	17.6	35.2	4.0
Hauling chaff and straw	28	19.6	36.8	4.2
Picking up grain sacks	18	8.2	23.4	2.7
Hauling grain to granary or to market [2]	22	23.2	92.4	10.5
Hauling fuel and oil	2	.1	.2	
Hauling seed [3]	16	1.1	2.6	.3
Roustabout	3	1.6	6.5	.8
Total miscellaneous work	19	2.8	9.3	1.1
Horse work done on farm	31		877.5	100.0
Horse work hired out	11		44.4	
Total horse work	31		921.9	
Horse work hired	13		55.7	
Total work by horses owned	31		866.2	

[2] 37.4 per cent, or 3,889 bushels per farm was hauled with motor truck.
[3] 18.4 per cent hauled with motor truck.

The operations most extensively done with horse-drawn implements were spike-tooth harrowing, weeding, and drilling (Tables 4 and 5). On the basis of once over the ground, there was an equivalent of 1,330 acres spike-tooth harrowed per farm, of which 1,214 acres, or 91 per cent, was done with horses. Twenty-eight men did all of their spike-tooth harrowing with horses. Most of these men used either a 1-man 6-horse or a 1-man 8-horse crew and a 20 or 24 foot harrow.

Weeding with horse-drawn weeders was reported on 25 farms. An average of 521 acres were weeded per farm, of which 474 acres, or 91 per cent, was with horses. A majority of these men used a 1-man 6-horse crew and a 12-foot weeder. The horse days spent in weeding averaged 122.2 per farm and amounted to 13.9 per cent of the total horse work per farm.

Drilling with horse-drawn drills was reported on 30 farms. Of a total of 568 acres of grain drilled per farm, 462 acres, or 81 per cent, was with horses. Twenty-six of these men did all of their drilling with horses. A majority used either four or six horses and a 10-foot or a 12-foot drill.

Spring plowing with horses was reported on 16 farms and amounted to 158 horse days or to 18 per cent of the total horse work per farm (fig. 4).

The total land preparation, seeding, and harvesting and threshing of grain crops amounted to 680.4 horse days per farm, or to 77.5

per cent of the total horse work. The man days per farm for this work amounted to 111.9.

The forage was mainly grain hay of which wheat hay, cut before the grain was fully ripe, constituted the larger part. Most of this grain hay was cut either with headers or with reapers. The haying work, together with the work of hauling chaff and straw, required a total of 72 horse days and amounted to 8.2 per cent of the total horse work per farm. Most of the grain hay was stored in barns, but the straw and chaff were hauled to stacks, usually near the feed lot, and fed out as needed.

Picking up and piling grain sacks and hauling grain to granary and to market required a total of 115.8 horse days and amounted to 13.2 per cent of the total horse work per farm (fig. 5). An average of 10,398 bushels of grain per farm was hauled to granary or to market, of which 3,889 bushels, or 37.4 per cent, was hauled by motor truck.

FIG. 4.—Spring plowing in preparation of land for summer fallow. Three 16-inch plows with a packer attached behind drawn by 16 horses. The acreage plowed with horses amounted to 24 per cent of the total acres spring plowed per farm

Miscellaneous work, such as hauling fuel and oil, hauling seed, and roustabout work amounted to an average of 9.3 horse days per farm. Eighteen and four-tenths per cent of the seed was hauled with motor trucks.

From a review of the work done with horses and tractors it will be seen that for those operations where the tractor competes with horses as a source of motive power, such as plowing, disking before plowing, and harvesting and threshing with the combine, tractors were preferred. On the other hand, spike-tooth harrowing, weeding, and drilling was done largely with horses. The former are operations which require great amounts of power and which are especially adapted to the use of large power units, whereas the latter are the lighter operations which often do not provide a full load for the power developed by the tractor.

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HORSE WORK EQUIVALENT OF TRACTOR DRAWBAR WORK ON TRACTOR FARMS

The total number of horse days that would have been required if the work requiring motive power had all been done with horses are indicated in Table 6. The horse work equivalent of the tractor work was arrived at in accordance with the following example: The land that was tractor plowed amounted to 421 acres per farm. Where

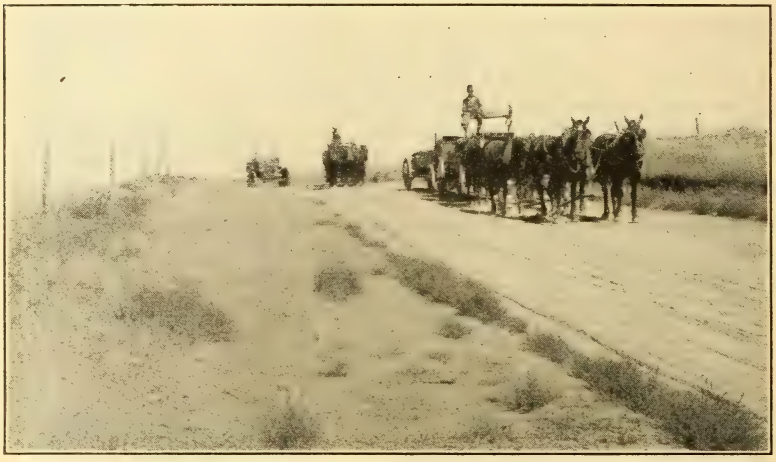

FIG. 5.—Hauling sacked grain to market with a six-horse team using trailer wagon. An average load for an outfit of this size is about 75 sacks or 175 bushels

horses were used, an average of 12 hours of horse work was required to plow an acre. Therefore the horse work equivalent of the tractor plowing amounted to 505.2 horse days per farm ($12 \times 421 \div 10$).

TABLE 6.—*Horse work equivalent of tractor drawbar work and proportion of different operations done with tractors on 31 tractor farms, 1922*

Operation	Horse work per farm	Horse work equivalent of of tractor work	Total horse work per farm	Percentage done with tractor
	Days	*Days*	*Days*	*Per cent*
Plowing	159.4	505.2	664.6	76
Harrowing:				
Spike tooth	197.4	18.6	216.0	9
Spring tooth	7.3	5.4	12.7	43
Disking	8.7	128.1	136.8	94
Rolling	2.8		2.8	
Weeding	122.2	12.2	134.4	9
Drilling	104.4	24.4	128.8	19
Harvesting and threshing:				
With combine	67.0	334.5	401.5	84
With header and stationary thresher	11.2		11.2	
Haying and hauling chaff and straw	72.0		72.0	
Picking up grain sacks and hauling	115.8		115.8	
Miscellaneous work	9.3	6.2	15.5	40
Total	877.5	1,034.6	1,912.1	54

On farms where tractors were owned the horse work equivalent of the total home tractor drawbar work amounted to 1,034.6 horse days per farm, or to 54 per cent of the total home drawbar work. The work stock were used during the year for an average of 57.6 days per head. Therefore, the average tractor did as much work as was done by 18 head of work stock on these farms (1,034.6÷57.6). On farms where tractors were not owned in 1922 the work stock were used an average of 69.5 days per head. Therefore, the average tractor did approximately as much work as was done by 15 head of work stock on nontractor farms (1,034.6÷69.5).

CHOICE OF TRACTOR WITH REFERENCE TO SIZE AND TYPE

The experience of some tractor owners has been that their tractors have proven unsatisfactory, because the size or type selected was not suited to their conditions. In deciding on the best size and type the experience of other tractor owners in the community, working under similar conditions, is a good guide to follow. The crawler, or track-laying type, is used almost universally in this region. This type is built low to the ground, does not overturn easily, and is well adapted for use on rolling slopes, such as are found on these farms.

In selecting a tractor many factors are to be taken into consideration. Perhaps the most important item is to select a size that is suitable for the amount and character of work to be done. As a measure of best size of tractor to buy for farms of different sizes, data have been grouped in Table 7 on the basis of the sizes recommended by owners who had had experience in the operation of tractors. As might be expected, with an increase in the tillable acres per farm the percentage of owners recommending tractors of the smaller sizes decreased, while the percentage recommending those of the larger sizes increased. Tractors of the 40-horsepower size were the ones generally recommended. In only two instances were tractors of less than 40 horsepower recommended for farms of 781 or more tillable acres.

TABLE 7.—*Size of farm, size of present tractor, and size of tractor recommended by 31 tractor owners if another were bought, 1922*

Item	Tillable acres per farm			
	780 and under	781 to 1,100	1,101 to 1,420	1,421 and over
Farms studied—number	9	9	4	9
Average tillable area per farm—acres	655	924	1,258	1,807
Owners having 10 h. p. tractors—per cent	34	11	0	0
Owners having 20 h. p. tractors—do	33	22	0	11
Owners having 28 h. p. tractors—do	0	11	25	11
Owners having 40 h. p. tractors—do	22	34	50	33
Owners having 50 h. p. tractors—do	11	22	25	45
Owners who would buy another tractor—do	56	33	100	89
Owners who would buy another 10 h. p. tractor—do	20	0	0	0
Owners who would buy another 12 h. p. tractor—do	20	0	0	0
Owners who would buy another 20 h. p. tractor—do	20	33	0	0
Owners who would buy another 28 h. p. tractor—do	0	0	25	0
Owners who would buy another 40 h. p. tractor—do	40	33	50	88
Owners who would buy another 50 h. p. tractor—do	0	34	25	12

Asked regarding the profitableness of tractors, 29 out of 40 owners thought the tractor a profitable investment but 11 thought otherwise. Table 8 shows that only 50 per cent of the owners of tractors of less than 28 horsepower thought they were profitable. Of the 28 tractor owners represented in the groups of 28 horsepower and over, 23 thought that their tractors were a profitable investment.

TABLE 8.—*Opinions of tractor owners relative to profitableness of tractors, 1922*

Size of tractor	Tractors of specified sizes	Owners who think the tractor is a profitable investment	Tractor owners who do not think the tractor is a profitable investment
	Number	*Number*	*Number*
10 horsepower	6	3	3
20 horsepower	6	3	3
28 horsepower	3	3	
40 horsepower	13	12	1
50 horsepower	12	8	4
Total	40	29	11

RELIABILITY OF TRACTORS

The number of days that a tractor is out of commission when needed for farm work is an important factor in determining its profitableness. Reliability of a tractor depends to a large extent on the skill and experience of the tractor operator in keeping it in good running order. It is not enough for the tractor operator to guide the tractor skillfully. He should possess enough mechanical skill to detect quickly any mechanical trouble which may occur, and should be able to remedy minor engine troubles promptly. If a tractor operator has a thorough knowledge of the operation of gas engines, he is often able to foresee and avoid long and serious delays. In addition, he should be certain that he can obtain repair parts and repair service promptly.

To determine the reliability of the tractors on these farms, a record was made as to the number of days in 1922 the tractor was out of running order when needed for farm work, and for what work it was needed during the time it was out of commission. Twenty-five tractor owners made complete answers to these questions. Eleven men reported that their tractors were not out of commission during the year; 14 reported time lost because of tractor trouble.

Fourteen tractor owners who reported time lost because of tractor trouble reported a total of 47.5 days lost, or, approximately, three and one-half days per tractor. During this time these tractors were needed for 27.5 days of plowing, 10 days of harrowing, and 10 days of combine work. Twenty-four of these 25 tractors were purchased new. Of 13 that had been used three years or less, 9 had not been out of order when needed and 4 had been out of order for an average of 6 days each. Of 11 tractors which had been used four years or

more, 3 had not been out of order when needed and 8 had been out of order for an average of 2.2 days each.

Reports of these tractor owners indicate that the tractor on these farms is a very dependable source of power when handled by an experienced tractor man.

OPINIONS OF TRACTOR OWNERS AS TO THEIR ADVANTAGES AND DISADVANTAGES

The opinions of tractor owners relative to the advantages and disadvantages of the use of tractors are given in Table 9 in the order of frequency of mention.

TABLE 9.—*Opinions of 40 tractor owners relative to their advantages and disadvantages, 1922*

Advantages of tractors in the order of frequency of mention	Number reporting	Disadvantages of tractors in the order of frequency of mention	Number reporting
More work in given time and work done in season	34	First cost and depreciation	23
Man labor saved	27	Incompetent operator	15
Displacement of horses	25	Time lost through breakage	14
Better work	25	Rough topography	14
Saving horses in hot weather	13	Running expenses	12
All other	4	All other	4

The ability of the tractor to do work quickly, and thus to perform the various field operations more nearly at the proper time, was an advantage mentioned the greatest number of times. Importance of early plowing and its effect on the yield of wheat is recognized by these farmers. Experiments at the Oregon experiment substation at Moro have shown that early spring plowing of summer fallow land has resulted in an appreciably larger yield of wheat per acre than late-plowed fallow land. From the standpoint of number of times mentioned, man labor saved through the use of tractor came second. An equal number thought that the number of horses displaced and the quality of work done with tractors was an important advantage. Saving of horses in hot weather was an advantage mentioned by 13 of 40 tractor operators.

The disadvantage mentioned by the greatest number of tractor operators was the first cost and depreciation. The fact that many of these tractors were bought at a time when the price was very high serves to make the item of capital invested in the tractor and depreciation of first importance. Lack of skill on the part of the tractor operator ranked second in number of times mentioned. The skill required to operate a tractor successfully is probably greater than for any other kind of farm machinery, and unless the owner is mechanically inclined and operates the tractor himself or is able to hire a thoroughly competent operator, he is almost certain to find his machine an unprofitable investment. Time lost because of breakage, rough topography, and running expenses were mentioned by approximately the same number of owners. Rough topography, as a disadvantage of tractor operation, is lessened to a large degree by the crawler type of tractor which is in general use in this county.

COST OF USING TRACTORS

Since cost items expressed as money units are subject to considerable change, especially during periods of wide price fluctuations, the items of expense incident to the operation of these tractors have been expressed, wherever possible, in terms of physical quantities. The figures representing the quantities and costs of fuel, lubricants, and days of repair work as well as other items of expense are averages for the three-year period, 1920 to 1922, and are the expenses incurred by the actual number of tractor owners reporting an expense for these items.

Over the three-year period records were obtained from the owners of thirteen 10-horsepower, seven 20-horsepower, five 28-horsepower, nineteen 40-horsepower, and thirteen 50-horsepower tractors, or for the period, a total of 57 different tractors were represented. Records were obtained on 30 of these tractors for 3 years, on 10 for 2 years, and on 17 for 1 year, making for the three-year period a total of 127 reports on the cost of using tractors, divided as follows: 25 reports on 10-horsepower, 17 on 20-horsepower, 10 on 28-horsepower, 45 on 40-horsepower, and 30 on 50-horsepower tractors.

In the following tables are shown the itemized cost of operating tractors of different sizes. The items which have been considered as operating cost are fuel, oils and grease, repairs, insurance, depreciation, and interest. The yearly cost, divided by the total number of 10-hour days the tractor was used during the year, is the average cost of operation per day. The number of hours the tractor was used on a given operation, multiplied by the cost per hour of operation, is the total tractor cost of this operation.

The average prices paid for fuel and cylinder oil for tractors and combines are shown in Table 10

TABLE 10.—*Average prices paid for fuel and cylinder oil for tractors and motor-driven combines, 1920–1922*

Item	Price per gallon		
	1920	1921	1922
	Cents	*Cents*	*Cents*
Gasoline	30.2	24.6	23.9
Kerosene	21.6	22.2	22.7
Distillate	20.9	21.7	21.5
Cylinder oil	91.6	89.3	87.7

FUEL, OILS, AND GREASE

Average quantities of fuel and cylinder oil used by tractors of different sizes, per year and per 10-hour day, are given in Table 11. The quantity of fuel used per day depends largely on the size of tractor, but with tractors of the same size the fuel consumption varied considerably.

TABLE 11.—*Fuel and cylinder oil requirements for tractors of different sizes, 3-year average 1920–1922,[1] 42 tractors, 1920; 45 tractors, 1921; 40 tractors, 1922*

Size of tractor	Total reports	Gasoline			Kerosene			Distillate			Cylinder oil		
		Tractors using gasoline	Quantity used per tractor		Tractors using kerosene	Quantity used per tractor		Tractors using distillate	Quantity used per tractor		Tractors using cylinder oil	Quantity used per tractor	
			Per year	Per 10-hour day		Per year	Per 10-hour day		Per year	Per 10-hour day		Per year	Per 10-hour day
Horsepower:	*No.*	*No.*	*Galls.*	*Galls.*	*No.*	*Galls.*	*Galls.*	*No.*	*Galls.*	*Galls.*	*No.*	*Galls.*	*Galls.*
10	25	4	364	19	16	542	20	5	885	24	25	34	1.3
20	17	16	1,136	38	------	------	------	1	975	33	17	77	1.9
28	10	5	3,811	46	------	------	------	5	2,415	48	10	132	2.0
40	45	38	3,869	51	------	------	------	7	5,366	56	45	148	1.9
50	30	25	3,381	64	------	------	------	5	3,761	73	30	151	2.8
All sizes	127	88	3,071	52	16	542	20	23	3,206	53	127	116	2.0

[1] Weighted averages, for example, the three-year average quantity of gasoline used per tractor was obtained by dividing the total gasoline consumed during the three years by the total number of tractors using the gasoline. The same method of averaging was used throughout this bulletin wherever the figures were possible of being weighted.

The average costs of fuel and oils per tractor and per 10-hour day are given in Table 12.

TABLE 12.—*Cost of fuel, oils, and grease for tractors of different sizes, average 1920–1922; 42 tractors, 1920; 45 tractors, 1921; 40 tractors, 1922*

Size of tractor	Average expense per tractor									
	Gasoline		Kerosene		Distillate		Cylinder oil		Other oils and grease	
	Per year	Per 10-hr. day	Per year	Per 10-hr. day	Per year	Per 10-hr. day	Per year	Per 10-hr. day	Per year	Per 10-hr. day
Horsepower:	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*
10	84.25	4.33	119.19	4.45	200.00	5.53	30.44	1.11	3.96	0.14
20	316.15	10.53	0	0	224.00	7.59	61.88	1.53	32.65	.81
28	1,011.80	12.17	0	0	463.80	9.19	127.60	1.91	72.80	1.09
40	1,026.28	13.62	0	0	1,159.57	12.08	121.89	1.55	75.22	.96
50	794.13	14.92	0	0	828.40	16.10	146.17	2.72	86.47	1.61
All sizes	804.69	13.43	119.19	4.45	687.04	11.35	102.04	1.80	57.96	1.02

CASH REPAIRS AND LABOR MAINTENANCE

The item of cash repairs, which includes the cash outlay for new parts and skilled labor in repair and machine shops off the farm, as well as the amount and cost of the labor spent by the tractor owner and other farm and expert labor on the farm in overhauling and repair work on tractors of different sizes is shown in Table 13. The number of tractor owners who spent some time in repair work on their tractors was relatively greater for the small than for the larger sizes, whereas the number who hired other labor was relatively greater for the large than for the smaller sizes.

TABLE 13.—*Cost of cash repairs and labor maintenance on farm of tractors of different sizes, 1920–1922; 42 tractors, 1920; 45 tractors, 1921; 40 tractors, 1922*

Size of tractor	Total reports	Cash repairs		Owner's labor			Other labor		
		Owners reporting	Expense per tractor per year	Owners reporting	Amount used per tractor per year	Expense per tractor per year	Owners reporting	Amount used per tractor per year	Expense per tractor per year
Horsepower:	*Number*	*Number*	*Dollars*	*Number*	*Days*	*Dollars*	*Number*	*Days*	*Dollars*
10	25	23	41.00	20	3	11.95	9	2	8.33
20	17	17	107.06	14	7	23.07	6	8	31.60
28	10	10	311.80	7	14	57.43	5	23	100.00
40	45	43	422.16	24	17	74.75	32	22	96.16
50	30	30	642.73	21	22	95.59	24	13	73.05
All sizes	127	123	352.16	86	13	55.87	76	16	74.23

INSURANCE, DEPRECIATION, AND INTEREST

The insurance, depreciation, and interest charges for tractors of different sizes are given in Table 14. A charge for insurance was reported 22 times, but only once for tractors of less than 40 horsepower.

TABLE 14.—*Cost of insurance, depreciation, and interest for tractors of different sizes, 1920–1922; 42 tractors, 1920; 45 tractors, 1921; 40 tractors, 1922*

Size of tractor	Total reports	Owners reporting insurance	Average per tractor per year		
			Insurance	Depreciation	Interest
Horsepower:	*Number*	*Number*	*Dollars*	*Dollars*	*Dollars*
10	25	0	0	171	38
20	17	1	53	561	163
28	10	0	0	687	123
40	45	14	93	858	249
50	30	7	78	819	182
All sizes	127	22	86	660	170

Depreciation was computed from estimates of owners as to the value of tractors at the beginning and end of the year and is an average for tractors of different ages. In computing this charge the resale value of old tractors was not considered.

An interest charge at the rate of 6 per cent was made against the average of the value of the tractor at the beginning and end of the year.

The average first cost, years of useful life, and depreciation of tractors of different sizes that were purchased new is given in Table 15. Tractors in this area are subjected to hard usage. They are used for very heavy work on rolling slopes, and are continually subjected to clouds of dust which sifts into the bearings and onto the track. The estimated average useful life for all tractors was 6.3 years. Tractor studies made in other areas showed that the life of the tractor in New York was about 6 years [2] and in the winter-wheat States of Oklahoma, Kansas, and Nebraska about 6.8 years.[3]

[2] Cornell Agr. Exp. Sta. Bul. 405. [3] U. S. Dept. Agr. Bul. 1202.

TABLE 15.—*Average cost, years of useful life and depreciation of tractors of different sizes, 42 tractors, 1920–1922* [1]

Size of tractor	Tractors	Average first cost	Useful life	Annual depreciation
Horsepower:	*Number*	*Dollars*	*Years*	*Dollars*
10	9	898	4.9	183
20	4	4,285	7.4	579
28	5	4,340	6.2	700
40	16	5,587	6.7	834
50	8	5,412	6.7	808

[1] Certain tractors have been omitted from this table because not purchased new or because of incomplete data on the year in which they were bought.

The first cost of tractors of the same size varied considerably, depending on the make of the tractor and the year in which it was bought. Tractors of the same size at the present time could be bought at appreciably lower prices.

TOTAL COST OF USING TRACTORS DURING YEARS OF SURVEY

The total cost of using tractors per year and per 10-hour day during each of the three years 1920, 1921, and 1922 is given in Table 16. The costs for tractors of the same size showed a wide variation, depending on the amount of work done, the difference in depreciation and repair charges, and the amount of fuel and oil used. In gereral, the different items of expense ranked in the following order: Fuel and oils, depreciation, repairs, interest, and insurance.

TABLE 16.—*Cost per year and per 10-hour day of using tractors of different sizes, 42 tractors, 1920; 45 tractors, 1921; 40 tractors, 1922*

Size of tractor	1920				1921				1922			
	Tractors	Amount of work per year	Cost		Tractors	Amount of work per year	Cost		Tractors	Amount of work per year	Cost	
			Per year	Per 10-hour day of use			Per year	Per 10-hour day of use			Per year	Per 10-hour day of use
Horsepower:	*No.*	*Days*	*Dolls*	*Dolls.*	*No.*	*Days*	*Dolls.*	*Dolls.*	*No.*	*Days*	*Dolls.*	*Dolls.*
10	9	29.6	422	14.26	10	29.2	472	16.17	6	21.4	343	16.07
20	5	45.3	1,569	34.64	6	44.9	1,324	29.48	6	31.7	1,069	33.72
28	4	68.2	2,196	32.21	3	61.2	2,058	33.63	3	70.6	2,181	30.88
40	15	86.7	3,350	38.64	15	77.7	2,895	37.25	15	71.2	2,419	33.97
50	9	64.3	3,152	49.02	11	51.1	2,900	56.68	10	47.1	2,437	51.70
All sizes	42	63.0	2,359	37.44	45	55.0	2,080	37.82	40	51.8	1,892	36.55

ESTIMATED COST OF USING TRACTORS

Table 17 gives an estimate of the 1923 and 1924 cost of operating the average size tractor found on these farms. In arriving at the cost of fuel and lubricants, the average quantities used for the three-year period 1920 to 1922 were charged at the prevailing prices to farmers for the years 1923 and 1924. The prevailing price in 1923

for fuel was: Gasoline, 20½ cents; kerosene, 18¼ cents; and distillate, 17¼ cents, per gallon. In 1924 the price of gasoline was 23½ cents; kerosene, 21 cents, and distillate 20¼ cents, per gallon. The prices for lubricants in 1923 and 1924 were approximately the same each year. During these years cylinder oil cost 85 cents per gallon; other oil, 14¾ cents per gallon, and hard grease, 9 cents per pound.

TABLE 17.—*Estimated cost of using tractors in 1923 and 1924 (averages for tractors of all sizes)*

Item	Quantity	Cost	
		1923	1924
Fuel and oils:		*Dollars*	*Dollars*
Gasoline—gallons	2,082	427	489
Kerosene—do	82	15	17
Distillate—do	651	112	132
Cylinder oil—do	116	99	99
Other oil—do	198	29	29
Hard grease—pounds	143	13	13
Repairs:			
Cash		281	281
Owner's labor—days	9	28	27
Other labor—do	10	45	44
Insurance		11	11
Depreciation		652	652
Total		1,712	1,794
Interest		141	141
Total cost per tractor		1,853	1,935
Cost per 10-hour day of use—days	56.6	32.74	34.19

The charge for labor maintenance was calculated by charging the average amounts of time spent by the owner and other man labor in the maintenance of these tractors over the period 1920 to 1922, at the prices which prevailed for such labor in 1923 and 1924. The cash repairs, insurance, depreciation, and interest charges are the same as those for the year 1922. The cost per 10-hour day of use in 1923 and 1924 is based on the average of the days of use over the period 1920 to 1922, inclusive.

EFFECT OF DAYS OF WORK PER YEAR ON COST OF OPERATING TRACTORS

The influence of the days of annual use on the cost of operating tractors in 1922 is illustrated in Table 18 and in Figure 6. The total cost per tractor hour of use decreased decidedly as the days of use increase, which, of course, is reflected in the cost of the operations performed with the tractor. The cost per tractor hour for those tractors used less than 30 days per year was $5.71, whereas those tractors used 60 days and over annually had an average cost of $3.04 per hour of use.

TABLE 18.—*Effect of days of work per year on cost of operating 22 tractors, 1922* [1]

Item		Days of work per year		
		Less than 30	30–60	60 and over
Tractors	number	9	7	6
Average tillable acreage per farm	acres	827	1,005	1,588
Average amount of work per tractor:				
Home work	days	20.63	37.07	76.42
Custom work	do	1.56	6.30	8.90
All work	do	22.19	43.37	85.32
Cost of using tractor:				
Fuel	dollars	228.44	478.43	966.17
Oils and grease	do	61.56	136.43	280.83
Repairs	do	173.38	353.40	422.86
Insurance	do			8.83
Depreciation	do	673.89	723.43	740.84
Total	do	1,137.27	1,691.69	2,419.53
Interest	do	130.11	126.43	171.50
Total cost per tractor	do	1,267.38	1,818.12	2,591.03
Average cost per 10hour day of use	do	57.11	41.92	30.37

[1] All farms on which a tractor of less than 20 horsepower was owned as well as those on which more than one tractor was owned or on which an excessive amount of contract horse or tractor work was done have been omitted from this table.

The average number of days of work per tractor for those tractors included in Table 18 was 46.1. The variation in the annual days of work per tractor was from 13 to 103.6. Increasing the number of days of annual use, merely for the purpose of reducing the cost per

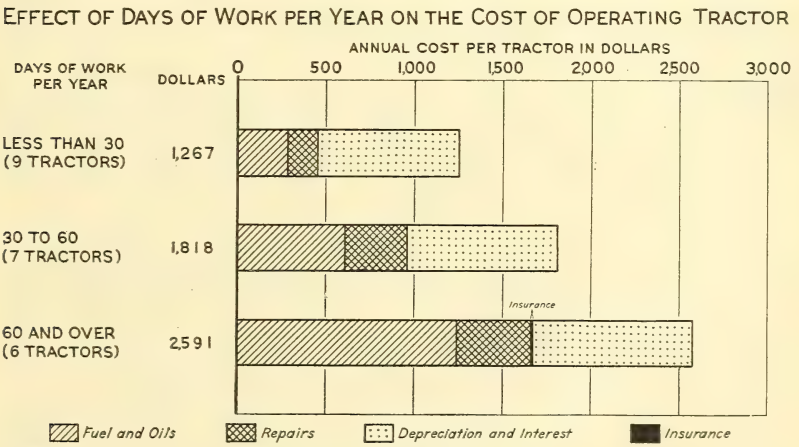

FIG. 6.—Cost of repairs, depreciation and interest was larger on the farms where a greater amount of work was done, but these costs did not increase in proportion to the increase in the number of tractor days of work per year. On the other hand there was a rather close relationship between the cost of fuel and oils and the number of days the tractor was used annually

day or hour of use, is not enough: the tractor should be engaged in profitable work. Size of farm is a large factor in determining the number of days of profitable use of tractors on these farms. The opportunity of custom work is also an item to be taken into consideration.

COST OF KEEPING WORK STOCK

The average cost of keeping work stock in 1922 on 92 farms is given in Table 19.

Of the total cost of keeping work stock on tractor farms, hay and roughage constituted 38.5 per cent; grain, 16.3 per cent; pasture, 12.7 per cent; and all other costs, 32.5 per cent. On nontractor farms the division of the total expense was as follows: Hay and roughage, 39.6 per cent; grain, 12.4 per cent; pasture, 13.5 per cent; and all other costs, 34.5 per cent.

TABLE 19.—*Annual cost per head of keeping work stock on tractor and nontractor farms, 1922*

Item	20 tractor farms		72 nontractor farms	
	Quantity	Cost	Quantity	Cost
Feed:	*Pounds*	*Dollars*	*Pounds*	*Dollars*
Hay	2,177	17.42	2,815	20.63
Straw	558	.70	425	.70
Chaff	5,373	14.50	3,820	9.37
Barley	348	6.45	263	4.78
Oats	88	1.53	108	1.97
Wheat	199	3.42	151	2.55
Mixed feed	136	2.45	25	.34
Salt		.32		.39
Grain pasture		1.53		1.29
Other pasture		9.20		9.18
Total feed		57.52		51.20
Chore labor		8.29		7.70
Harness and building charge		6.01		6.28
Veterinary service		.42		.34
Shoeing		.68		.11
Feed grinding		.06		.08
Depreciation		5.86		5.80
Interest		5.88		6.00
Total		84.72		77.51

FEED

The hay used on these farms was mostly wheat hay. On tractor farms the average consumption of hay and other roughage per head was 8,108 pounds, and on nontractor farms 7,060 pounds. The consumption of hay alone on nontractor farms was 638 pounds per head greater than on tractor farms, whereas the consumption of straw and chaff was 1,686 pounds greater per head on tractor farms.

The grain ration fed as grain on both tractor and nontractor farms was low because of the grain consumed in the grain hay. The consumption of grain averaged 224 pounds per head greater on tractor than on nontractor farms. Of the total quantity of grain fed on tractor farms, barley constituted 45.2 per cent; oats, 11.4 per cent; wheat, 25.8 per cent; and mixed feed, 17.6 per cent. Of the total quantity of grain fed on nontractor farms barley constituted 48.1 per cent; wheat, 27.6 per cent; oats, 19.7 per cent; and mixed feed, 4.6 per cent.

The cost of feed on tractor farms varied from $25 to $96 per head. On 4 tractor farms the cost of feed per head was less than $45; on 6 farms the cost was from $45 to $55 per head; and on 10 farms the cost was over $55 per head. On nontractor farms the cost of feed

varied from $20 to $127 per head. On 23 nontractor farms the cost of feed per head was less than $45; on 19 farms the cost was $45 to $55; and on 30 farms the cost was over $55.

The charge for grain pasture is for land seeded especially for pasture purposes, and usually consisted of rye or wheat. The charge for other pasture includes stubble, native grass, and hired pasture.

CHORE LABOR

The amount of man labor spent in the care of work stock averaged 27.8 hours per head on tractor farms and 25.8 hours per head on nontractor farms. The amount of man labor spent in taking care of work stock on tractor farms varied from 13.6 to 51.2 hours per head; on nontractor farms the variation was from 6.6 to 76.8 hours per head. The value of the time spent in taking care of work stock was placed at 30 cents per man hour on both tractor and nontractor farms.

HARNESS AND BUILDING CHARGE

These costs include repairs and depreciation of harness and miscellaneous equipment, and buildings used to house the horses and store their feed.

SHOEING

Six farmers out of 20 on tractor farms reported a shoeing expense, whereas only 7 out of 72 nontractor farmers reported this expense.

DEPRECIATION AND INTEREST

Depreciation is the difference in the value of all horses and colts at the beginning and at the end of the year after making proper credits or debits for breeding fees, and animals bought or sold during the year. Differences in values were due to injuries, deaths, and change in age; differences in values due to declining prices were not considered as depreciation. On 25 farms there was an appreciation in the value of all work stock.

Interest at the rate of 6 per cent of the value of the work stock was charged as a cost.

ESTIMATED COST OF KEEPING WORK STOCK

An estimate of the cost per head of keeping work stock in 1923 and 1924 on tractor and nontractor farms is given in Table 20. The cost of feed was arrived at by charging the average quantities of roughage and grain that were fed in 1922, at the prevailing farm prices for these feeds in Sherman County, in 1923 and 1924. The charge for pasture was made to follow the increase or decrease in the value of grain hay. The harness and building charge and the charge for chore labor, veterinary services, shoeing, and depreciation were allowed to remain the same as in 1922.

The reports of the Division of Crop and Livestock Estimates show that the average value of horses in Oregon in 1923, based on monthly farm prices, was 102 per cent, and in 1924, 89 per cent of their value in 1922. Interest charges were made according to the increase or decrease in the farm value of horses for these years as compared with 1922.

TABLE 20.—*Estimated cost per head of keeping work stock, 1923 and 1924*

Item	1923				1924			
	Tractor farms		Nontractor farms		Tractor farms		Nontractor farms	
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Feed:	*Pounds*	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*
Hay	2,177	16.32	2,815	21.11	2,177	14.69	2,815	19.00
Straw	558	.84	425	.64	558	.84	425	.64
Chaff	5,373	14.78	3,820	10.50	5,373	13.43	3,826	9.56
Barley	348	6.09	263	4.60	348	6.09	263	4.60
Oats	88	1.54	108	1.89	88	1.54	108	1.89
Wheat	199	3.08	151	2.34	199	3.94	151	2.99
Mixed feed	136	2.72	25	.50	136	2.72	25	.50
Salt		.32		.39		.32		.39
Grain pasture		1.54		1.30		1.39		1.17
Other pasture		9.28		9.26		8.35		8.33
Total feed		56.51		52.53		53.31		49.07
Chore labor		8.29		7.70		8.29		7.70
Harness and building charge		6.01		6.28		6.01		6.28
Veterinary service		.42		.34		.42		.34
Shoeing		.68		.11		.68		.11
Feed grinding		.06		.08		.06		.08
Depreciation		5.86		5.80		5.86		5.80
Interest		6.00		6.12		5.23		5.34
Total		83.83		78.96		79.86		74.72

RELATION OF HOURS WORKED PER HEAD PER YEAR TO THE COST OF KEEPING WORK STOCK AND THE COST PER HOUR OF HORSE WORK

The cost per hour of horse work for each farm was computed by dividing the total cost of keeping the work stock by the total annual hours of horse work for each farm. In general, as the hours worked per head per year increased, there was some increase in the cost per head of keeping work stock, but a very much greater decrease in the cost per hour of horse work. This relationship is clearly shown in Table 21.

TABLE 21.—*Relation of hours worked per head per year to the cost of keeping work stock and the cost per hour of horse work on 20 tractor farms, 1922*

Hours worked per head per year	Farms	Average hours worked per head per year	Net cost of keeping one horse	Cost per hour of horse work
	Number	*Number*	*Dollars*	*Cents*
Less than 500	5	359	87	24
500 to 650	6	596	89	15
650 and over	9	786	94	12

RELATIVE ECONOMY AND EFFICIENCY IN USE OF HORSES AND TRACTORS

To warrant the purchase of a tractor, it is evident that a man should be able to reduce the number of work stock kept, or in some other way make changes which will increase the economy or efficiency of his farming operations.

In the following tables the farms on which tractors were owned are compared with all nontractor farms, the average size of which

was somewhat smaller than the tractor farms, and with a group of selected nontractor farms which were of approximately the same size as the tractor farms. The data collected do not permit comparisons of changes which have occurred on the same farms before and after the purchase of a tractor, but the type of farming was similar and the division of the tillable area between summer fallow and grain crops was in about the same proportion on both tractor and nontractor farms.

On farms where tractors were owned the tillable area per farm averaged 173 acres greater than on farms where tractors were not owned. On 77 per cent of the nontractor farms the tillable area was less than the average for the tractor farms, but on 23 per cent it was larger. Since the cost per hour of tractor work depends to a large extent on the number of days the tractor is used, the cost per hour is higher on small farms than on larger farms, unless outside tractor work is done to offset the higher overhead expense. It is not always possible to increase the acreage farmed after the purchase of a tractor, but in the region under consideration many men have increased their acreage by renting additional land. Over the period 1920–1922, 54 per cent of these tractor owners rented additional land which averaged 752 tillable acres per farm.

The combined months of hired-man labor, family labor, and operator's labor averaged 28.6 months per farm on tractor farms and 26 months on all nontractor farms, but the nontractor farms were 173 tillable acres smaller than the tractor farms. On nontractor farms of approximately the same tillable acreage per farm as the tractor farms, the total months of man labor per farm averaged 29.4.

Expressed in terms of tillable area per man, each man farmed 41 acres more on tractor farms than on all nontractor farms, and 19 acres more than on the group of nontractor farms that were approximately the same size as the tractor farms. (See Tables 22, 23, and 24.)

On tractor farms there was an average of 3.7 less head of work stock than on all nontractor farms, and 6 less per farm than on the group of nontractor farms that were approximately the same size as the tractor farms. The average cost per farm of keeping work stock was $138 less on tractor farms than on all nontractor farms and $317 less than on the group of nontractor farms of approximately the same size as the tractor farms. On the other hand, the net cost of keeping work stock averaged $97 per head on tractor farms, as against $85 on all nontractor farms, and $85 on the group of nontractor farms that were approximately the same size as the tractor farms. On tractor farms the hours worked per head averaged 131 less than on all nontractor farms and 181 less than on the group of nontractor farms of approximately the same size as the tractor farms. On tractor farms the cost per hour of horse work was 4 cents higher than on all nontractor farms and 5 cents higher than on the nontractor farms which were comparable in size to the tractor farms.

Studies of the cost and utilization of work stock on tractor and on nontractor farms in other regions have, in many cases, shown a smaller number of hours of horse work per head on tractor farms together with a lower cost of maintenance per head. There appear, however, to be several reasons why the cost of maintenance of work

stock on these tractor farms, as well as on those in a number of other regions, should be greater than on nontractor farms, even where the number of hours of horse work per head was smaller on the tractor farms.

In the case of Sherman County farms on which tractors were owned, the quantities of grain fed, the hours of human labor spent in the care of work stock, and the charges for most other items were somewhat greater than on nontractor farms. On nontractor farms a surplus of work stock was kept for harvest work with the combine which were of a lower grade than the smaller number kept on tractor farms. These horses on nontractor farms were fed generous quantities of wheat hay, especially during the harvest season, and lesser quantities of threshed grain and mixed feed than those on tractor farms.

As a general rule it may be stated that, after the purchase of a tractor, the number of horses that must be kept on the farm is measured by the amount of work that occurs at rush periods which can be done better and more economically with horses than with tractors. There are cases, however, where it is preferable to hire some horses to perform the necessary horse work rather than carry through the year extra horses which are needed for relatively short periods of time when the peak loads of work occur. It is not always possible to hire extra horses when needed; but during the period of this survey many of these men could and did hire extra horses to provide sufficient horse power at rush periods. Of 31 tractor owners (Table 5), 13 hired horses which amounted to an average of 55.7 horse days per farm.

TABLE 22.—*Size of farm, cost of man labor, cost of keeping work stock, cost of using tractor, and total cost of man labor and motive power. Tractor farms, 1920–1922* [1]

Item	1920	1921	1922	3-year average
Farms—number	23	27	20	
Size of farm—acres	1,175	1,105	1,296	1,183
Tillable area per farm—do	909	882	998	924
Wheat—do	406	385	468	416
Other crops—do	32	41	58	43
Summer fallow—do	471	456	472	465
Months of hired labor per farm—number	13.2	16.1	14.2	14.6
Months of family labor per farm—do	2.3	.9	3.2	2
Cost of man labor per farm excluding operator—dollars	2,887	2,048	1,903	2,282
Cost of man labor per farm including operator—do	4,109	3,208	2,733	3,368
Tillable acres per man including operator—number	397	365	407	388
Work stock per farm—do	13.2	14.6	16.2	14.6
Value of work stock per farm—dollars	1,736	1,756	1,596	1,704
Value of work stock per head—do	132	120	98	117
Cost of keeping work stock per farm—do	1,543	1,361	1,373	1,424
Grain fed per head of work stock—pounds	971	871	771	869
Hay and roughage fed per head of work stock—do	8,624	8,979	8,108	8,597
Cost per head of keeping work stock—dollars	117	93	85	97
Horse work per head of work stock—hours	632	731	564	649
Cost per hour of horse work—cents	19	13	15	15
Tillable acres per head of work stock—number	69	60	62	63
Cost of using tractor per farm—dollars	1,914	1,528	1,665	1,694
Total cost of motive power per farm—do	3,457	2,889	3,038	3,118
Total cost of motive power per tillable acre—do	3.80	3.28	3.04	3.38
Total cost of man labor and motive power per farm—do	7,566	6,097	5,771	6,486
Total cost of man labor and motive power per tillable acre—do	8.32	6.91	5.78	7.02

[1] Certain farms have been omitted from this table for various reasons, such as, data incomplete with respect to months of man labor hired, an excessive amount of contract horse or tractor work, and other irregularities making them incomparable with the farms included in Tables 23 and 24.

TABLE 23.—*Size of farm, cost of man labor, cost of keeping work stock and total cost of man labor and motive power. All nontractor farms, 1920–1922* [1]

Item		1920	1921	1922	3-year average
Farms	number	56	79	72	
Size of farm	acres	1,004	992	1,022	1,006
Tillable area per farm	do	740	756	755	751
Wheat	do	347	333	333	337
Other crops	do	48	51	49	50
Summer fallow	do	345	372	373	365
Months of hired-man labor per farm	number	10.4	12.2	9.1	10.6
Months of family labor per farm	do	4.7	2.5	3.4	3.4
Cost of man labor per farm excluding operator	dollars	1,732	1,354	1,008	1,336
Cost of man labor per farm including operator	do	2,915	2,393	1,818	2,334
Tillable acres per man including operator	number	328	340	370	347
Work stock per farm	do	17.9	18.4	18.6	18.3
Value of work stock per farm	dollars	2,151	2,034	1,863	2,006
Value of work stock per head	do	120	111	100	109
Cost of keeping work stock per farm	do	1751	1,521	1,460	1,562
Grain fed per head of work stock	pounds	584	664	547	602
Hay and roughage fed per head of work stock	do	6,742	7,896	7,060	7,298
Cost per head of keeping work stock	dollars	98	83	78	85
Horse work per head of work stock	hours	791	849	695	780
Cost per hour of horse work	cents	12	10	11	11
Tillable acres per head of work stock	number	41	41	41	41
Cost of keeping work stock per tillable acre	dollars	2.37	2.01	1.93	2.08
Total cost of man labor and motive power per farm	do	4,666	3,914	3,278	3,896
Total cost of man labor and motive power per tillable acre	do	6.30	5.18	4.34	5.19

[1] Certain farms have been omitted from this table for various reasons, such as data incomplete with respect to months of man labor hired, an excessive amount of contract horse or tractor work, and other irregularities making them incomparable with the farms included in Tables 22 and 24.

TABLE 24.—*Size of farm, cost of man labor, cost of keeping work stock, and total cost of man labor and motive power. Nontractor farms of a size comparable with the farms on which tractors were owned, 1920–1922* [1]

Item		1920	1921	1922	3-year average
Farms	number	30	54	37	40
Size of farm	acres	1,269	1,166	1,294	1,230
Tillable area per farm	do	909	861	966	905
Wheat	do	426	374	433	405
Other crops	do	58	58	58	58
Summer fallow	do	425	429	475	442
Months of hired labor per farm	number	12.8	14.0	13.1	13.4
Months of family labor per farm	do	4.9	3.1	4.4	4.0
Cost of man labor per farm excluding operator	dollars	2,272	1,522	1,375	1,663
Cost of man labor per farm including operator	do	3,481	2,589	2,246	2,705
Tillable acres per man including operator	number	367	355	393	369
Work stock per farm	do	19.3	20.1	22.4	20.6
Value of work stock per farm	dollars	2,377	2,219	2,182	2,247
Value of work stock per head	do	123	110	97	109
Cost of keeping work stock per farm	do	1,934	1,657	1,705	1,741
Grain fed per head of work stock	pounds	541	650	559	594
Hay and roughage per head of work stock	do	7,524	8,158	7,316	7,731
Cost per head of keeping work stock	dollars	100	82	76	85
Horse work per head of work stock	hours	880	876	737	830
Cost per hour of horse work	cents	11	9	10	10
Tillable acres per head of work stock	number	47	43	43	44
Cost of keeping work stock per tillable acre	dollars	2.13	1.93	1.77	1.92
Total cost of man labor and motive power per farm	do	5,415	4,246	3,951	4,446
Total cost of man labor and motive power per tillable acre	do	5.96	4.93	4.09	4.91

[1] Certain farms have been omitted from this table for the reasons stated for Tables 22 and 23 and for the additional reason that they were not of a size that was comparable with the tractor farms included in Table 22.

The difference in average cost of motive power for the two classes of farms is greater than it would have been had all farmers who purchased tractors disposed of the maximum number of work stock. The total cost of motive power is not reduced by the use of a tractor if used merely as an addition to the power already on the farm.

The purchase of a tractor should imply the need for additional power or the substitution of tractors for horses and consequently a reduction in the number of horses kept.

It should be kept in mind that the cost of operating tractors and using horses varies as changes occur in the prices of work stock, feed, tractors, fuel, oil, etc., and that, notwithstanding the higher cost of tractor motive power during the years of the study, many farmers preferred the tractor to horses. This is particularly true on the larger farms where large acreages needed to be tended in a comparatively short time.

Some of the advantages and disadvantages of tractors are not easy of measurement, but, in general, the opinions of these tractor owners as given on page 13 indicate that the tractor has a number of real advantages on many of these farms.

SEASONAL DISTRIBUTION OF HORSE AND TRACTOR WORK

On these farms where wheat production is the principal enterprise the greatest demand for horse work occurs in March and April, when the land is being plowed and disked, and again in July and August during the harvest season. The number of horses that must be kept is governed largely by the demand for horse work at these two periods of the year. The farms in this area are, for the most part, well adapted to the use of tractors which, after their purchase, should displace a considerable number of horses.

The distribution of horse work on a certain Sherman County wheat farm in 1922 before the purchase of a tractor is shown in Figure 7. The owner of this farm exchanged the use of his combine for the use of a neighbor's tractor in harvest so that his combine was drawn by a tractor. The amount of horse work that would have been required had the power for harvesting been supplied by horses has been estimated, as well as the number of horses required to operate the farm had all of the work been done with horses. On this basis it is assumed that 24 horses would have been sufficient to operate this farm and the total horse hours would have amounted to 17,272, or 720 hours per horse per year.

It will be seen that the "peak" of horse work occurred during the latter part of March and the harvest period of July. The horse work performed in March consisted of disking unplowed land and plowing in the preparation of summer fallow land. During the last 10-day period of March a total of 1,472 horse hours was devoted to plowing. Plowing was started March 16. The work in April was a continuation of disking unplowed land and plowing. Plowing continued until May 12, from which time until harvest started on July 10, the horse work consisted principally of weeding.

Harvesting was at its height during the middle 10-day period of July, and, with wheat hauling for that period, amounted to a total of 1,592 hours of horse work. The harvest work (hauling) ended August 26. The horse work in September and October consisted principally of drilling, together with a limited amount of weeding and harrowing in the preparation of a suitable seed bed.

In April of 1923 a 40-drawbar horsepower tractor was purchased. The distribution of the horse and tractor hours after the purchase

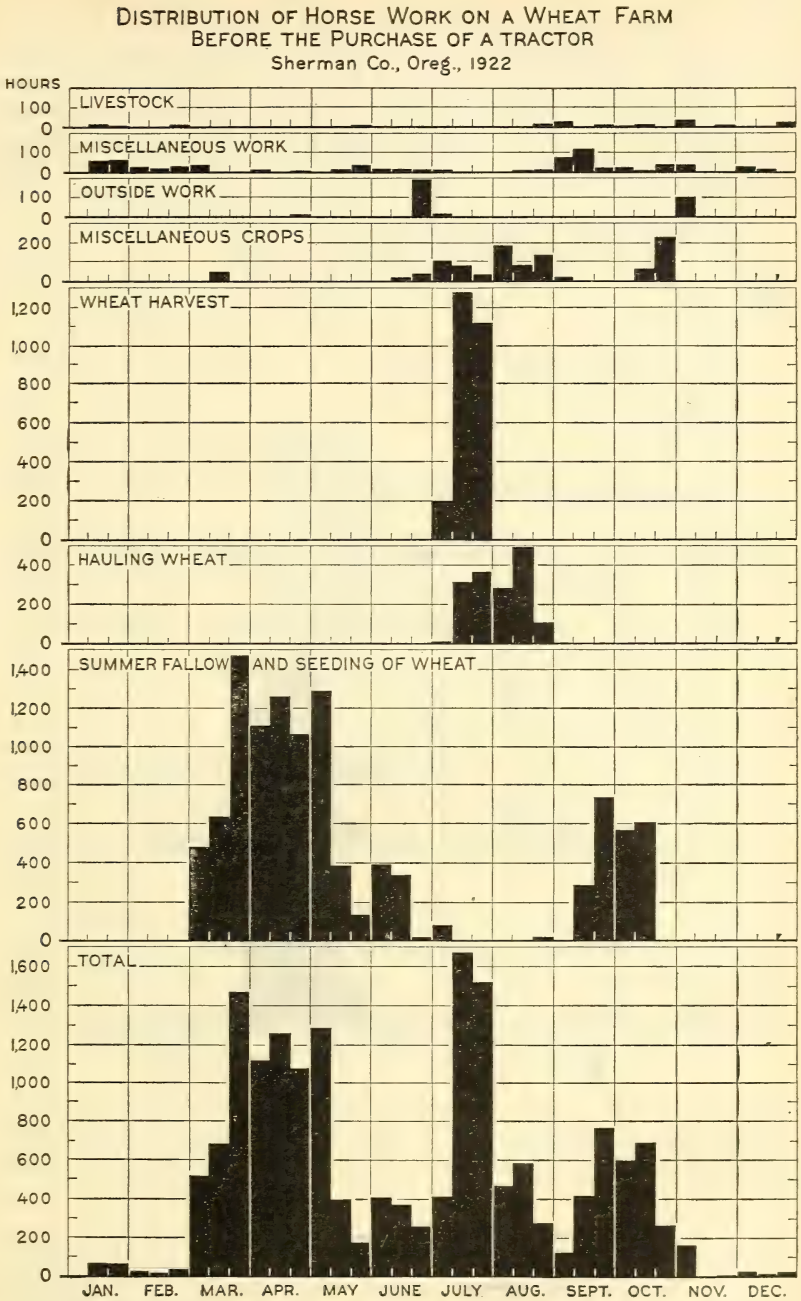

FIG. 7.—Tillable area of farm 795 acres, divided as follows: Winter wheat, 390 acres; summer fallow, 400 acres; alfalfa, 5 acres; wheat hauled to market, 8,367 bushels. Work done off farm: 315 horse hours hauling wheat and roadwork; twenty-four horses working 17,272 hours were required to do this work

of the tractor is shown in Figure 8. Before the purchase of the tractor some land was plowed and disked with horses. The horse hours for this work have been converted into their equivalent in tractor hours. All but four head of the work stock was sold at the time of the purchase of the tractor and the wheat was contract-hauled to market. The use of large equipment with proper hitches and eveners allowed a much greater reduction in the number of work stock than usually occurs on these farms after the purchase of a

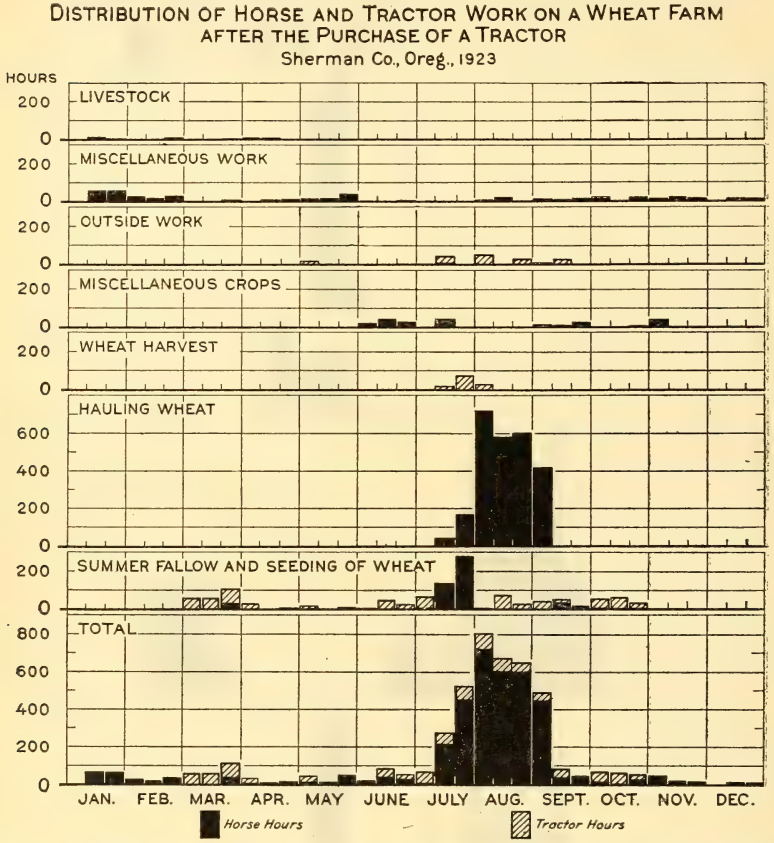

FIG. 8.—Tillable area of farm, 795 acres, divided as follows: Winter wheat, 400 acres; summer fallow, 390 acres; alfalfa, 5 acres. Wheat hauled to market, 13,220 bushels. Work done off farm: Summer fallow work except plowing on 303 acres; seeding, 303 acres; also 160 hours of tractor work, mainly combine harvesting. Eight horses worked 3,688 hours, and the tractor was used 995 hours during the year

tractor. It is estimated that with the tractor eight horses would have been sufficient to do the farm work. After the purchase of the tractor, the number of horses needed was measured by the amount of wheat hauling there was to do, the "peak" of which occurred in the first 10-day period of August, and amounted to 720 horse hours.

The total horse hours for the year amounted to 3,688. The tractor hours amounted to 995, of which 160 hours consisted of outside work, mainly harvesting and threshing with the combine.

WORK DONE PER DAY WITH HORSES AND WITH TRACTORS

On these farms 10 hours of work with the tractor accomplished nearly two and one-half times the amount of plowing done with horses. (Table 25.) For other operations, such as harrowing, disking, weeding, and drilling, the tractor farmers did from two to three times as much work in 10 hours as did those who used horses. On some farms where horses alone were used for motive power, this difference was not so great because of the use of large teams and machines. Large units of power are useful at rush periods, permitting a maximum amount of work to be done with a minimum of man labor, and at the proper time.

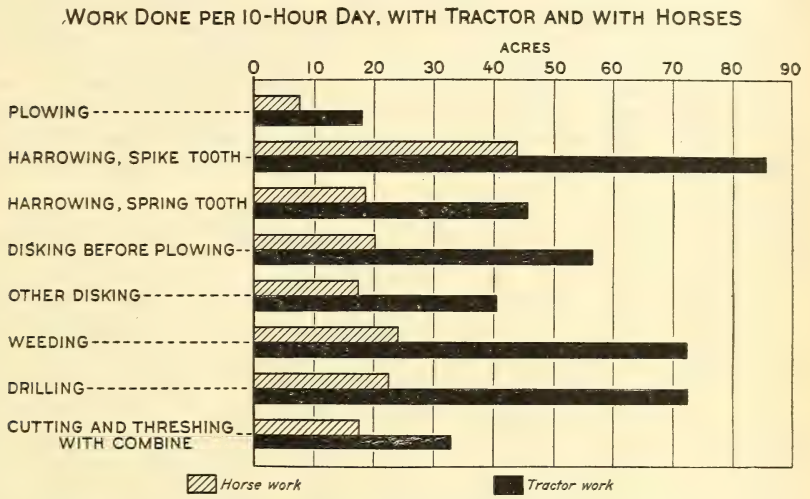

FIG. 9.—The work accomplished per 10-hour day for all operations was very much greater where tractors were used

As these farms were handled during the years of the survey, the use of tractors resulted in a saving of man labor in the performance of the various field operations amounting to from 0.1 to 0.6 hours per acre. The work accomplished per 10-hour day with tractors and with horses is shown graphically in Figure 9.

TABLE 25.—*Work done per 10-hour day with tractor and with horses, horse-equivalent of tractor work, and saving in man labor*

Operation	Work done per 10-hour day with—		Horse-equivalent of tractor work [1]	Saving in man labor per acre when done with tractor
	Tractor	Horses		
	Acres	*Acres*	*Number*	*Hours*
Plowing	18.0	7.6	21.6	0.6
Harrowing:				
Spike tooth	85.7	43.9	13.8	.1
Spring tooth	45.6	18.7	14.5	.3
Disking before plowing	56.5	20.2	33.3	.3
Other disking	40.5	17.4	16.0	.2
Weeding	72.3	24.0	18.8	.3
Drilling	72.4	22.5	16.7	.1
Cutting and threshing with combine	32.8	17.6	24.6	.4

[1] By horse-equivalent of tractor work is meant the number of horses that would be required to do the same amount of work as was done by the tractor.

In general, it may be said that the operations on which the tractor was most generally used (plowing, disking before plowing, and harvesting with the combine) are operations which replaced a large number of horses and at the same time saved man labor.

TYPES OF COMBINES

As classified herein, motor-driven combines are those that have an engine installed on the machine to operate the mechanism of the separator and are drawn over the ground either with horse or tractor power. Ground-power combines derive their power for operating the mechanism of the separator from the traction of the wheels, as the machine is drawn over the ground. The quality of the work done by ground-power combines is generally considered to be inferior to that of motor-driven machines, and the ground-power type is fast becoming obsolete. Table 26 gives the number of each type of combine on the farms studied, classified by size (length of cutter bar). Hereafter no reference will be made to the ground-power type, all figures and discussion dealing exclusively with the more important type—the motor-driven combine.

TABLE 26.—*Number of motor-driven and ground-power combines, by sizes, 1920–1922*

Type and size (Length of cutter bar, feet)	Combines			Percentage of total number of combines		
	1920	1921	1922	1920	1921	1922
Motor-driven type:	*Number*	*Number*	*Number*	*Per cent*	*Per cent*	*Per cent*
9	23	22	21	32	27	26
12	12	16	15	17	19	19
14	3	6	7	4	7	9
16	5	7	4	7	9	5
18	12	14	15	17	17	19
20	13	13	14	18	16	17
22	1	1	1	1	1	1
24	3	3	3	4	4	4
Total	72	82	80	100	100	100
Ground-power type:						
9	19	16	15	70	62	66
12	4	4	3	15	15	13
14	4	4	3	15	15	13
16		1	1		4	4
18		1	1		4	4
Total	27	26	23	100	100	100

CHOICE OF COMBINE WITH REFERENCE TO SIZE

The size of combine now owned, the percentage of owners who would buy another combine when the present one is worn out or becomes obsolete, and the size recommended if another was bought is shown in Table 27. All but two owners stated that they would buy another combine when needed. Of the total number recommending the purchase of another combine, about 30 per cent recommended the 12-foot and 21 per cent recommended the 18-foot combine.

TABLE 27.—*Size of combine now owned and size of combine recommended if another was bought, as reported by the owners of 78 combines, 1922*

Size of combine now owned (Length of cutter bar, feet)	Combine owners	Average tillable acreage per farm	Owners who would buy another when needed	Percentage of owners of various sizes of combines who recommend a combine of size indicated [1]						
				Size indicated						
				9 feet	12 feet	14 feet	16 feet	18 feet	20 feet	24 feet
	Number	*Acres*	*Number*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
9	21	672	21	24	57	5	14	0	0	0
12	15	987	14	0	57	7	14	7	15	0
14	7	790	6	0	0	67	33	0	0	0
16	4	1,199	4	0	0	0	100	0	0	0
18	14	1,106	14	0	14	7	0	79	0	0
20	13	1,540	13	0	0	0	8	23	69	0
22	1	1,235	1	0	0	100	0	0	0	0
24	3	1,192	3	0	34	0	0	33	0	33
All sizes	78	1,020	76	7	30	11	16	21	14	1

[1] Percentages based on number of owners who would buy another combine when present one is worn out or becomes obsolete.

Approximately 24 per cent of the owners of 9-foot combines recommended one of this size, because its operation required a small crew and was suitable for their particular size of farm. The tillable acreage of these farms ranged from 445 to 700 per farm, and averaged 672. On the other hand 57 per cent of the owners of the 9-foot combine favored the 12-foot size, giving as reasons that it has a leveling device, and that with the same number of men one of this size will do more work in a given time than the 9-foot size.

All but one of the owners of 12-foot combines said that they would buy another when needed and 57 per cent recommended this size. Their reasons were that it would cut their grain in season and was best adapted to their size of farm. These farms ranged in size from 460 to 1,043 tillable acres and averaged 987 tillable acres per farm.

Of those owning 14-foot combines all but one recommended the purchase of another when needed. Thirty-three per cent of this group said that they would buy a 16-foot combine stating that, with the same crew, one of this size would do more work than a 14-foot combine; 67 per cent recommended the purchase of another 14-foot combine for the reason that one of this size was best suited to their size of farm. These farms ranged in size from 600 to 1,000 tillable acres and averaged 790 tillable acres per farm.

All of the owners of 16-foot combines recommended the purchase of a combine of this size. One man stated that it was a good size for his 28-horsepower tractor, and another said that a combine of this size was large enough to handle his crop and worked well on steep land. The range in tillable acres per farm for those men who recommended 16-foot combines was from 541 to 2,240. The average size was 1,199 tillable acres per farm.

Approximately 14 per cent of the owners of 18-foot combines recommended the purchase of a 12-foot combine, and 79 per cent recommended the purchase of an 18-foot combine. The tillable acreage for those men who recommended 18-foot combines ranged from 700 to 2,570, and averaged 1,106 acres per farm. These men were satis-

fied with the 18-foot combine, because of its adaptability to their size of farm. They were of the opinion, also, that larger sizes wasted more grain in "draws."

Of the owners of 20-foot combines, 23 per cent favored the 18-foot combine, giving among other reasons that it is lighter than the 20-foot combine; that it is adapted for use with a 40-horsepower tractor, and that a larger machine wastes more grain in "draws." Sixty-nine per cent recommended the purchase of a 20-foot combine. The tillable acreage per farm for those in this group ranged from 505 to 2,238 and averaged 1,540.

The one man who owned a 22-foot combine recommended the purchase of a 14-foot combine, giving as a reason that they are less expensive to maintain.

Of the three men who owned 24-foot combines, one stated that a 12-foot machine was large enough for his farm; another recommended an 18-foot combine, for the reason that the 24-foot machine was too large for his tractor, and that it packed the ground too much. The one man who favored a 24-foot combine gave no reason for his choice.

OPINIONS OF COMBINE OWNERS AS TO THEIR ADVANTAGES AND DISADVANTAGES

Opinions of owners relative to the advantages and disadvantages of the use of combines will be found in Table 28. Of the advantages, man labor saved was reported the greatest number of times and was followed in order by the statement that the cost of using the combine was less than that of using the stationary thresher. Third in order of frequency of mention was the statement that the combine enabled the harvest work to be done more nearly in season. In addition, there is the advantage of less danger from fire hazard, and the fact that the wheat grower can market his crop earlier and thus get ready cash to pay accumulated and current debts incident to the production of the crop.

TABLE 28.—*Opinions of 101 owners as to advantages and disadvantages of use of combines, 1922*

Advantages of combines in the order of frequency of mention	Owners reporting	Disadvantages of combines in the order of frequency of mention	Owners reporting
	Number		*Number*
Man labor saved	75	Scatters straw and chaff	39
Cheaper than stationary thresher	62	Wastes grain	20
Threshing in season	43	Scatters grain sacks	18
Saves horses and horse work	36	Scatters weed seeds	10
Adapted for harvesting in windy weather	21	Packs soil	6
Saves grain	18	High repair cost	5
Separates chaff from straw	11	Rough topography	5
Men prefer combine harvesting	5	First cost and depreciation	2
		Mechanical trouble	2

A saving in horses and horse work was mentioned by 36 combine owners, and 21 reported as an advantage that the combine is adapted to harvesting work in windy weather. This is because there is a minimum of handling of the headed grain and a minimum of loss from delayed threshing and handling of the threshed grain.

Thirty-nine reported as a disadvantage that the combine scatters the straw and chaff. The straw and chaff is not left in large stacks, as is the case with the stationary thresher, but is left in small piles. They can be readily picked up with forks and hauled to stacks for feeding.

Eighteen owners said there was a saving in grain by the use of the combine, but 20 reported that the combine method of harvesting wastes grain. The combine wastes grain in two ways: (1) Through shattering in the field if left standing too long before harvesting and (2) because of inefficient handling of the machine by the separator tender. It requires a more experienced man to handle a combine as effectively as a stationary outfit, but a good separator tender can so handle his machine that very little grain is lost through the machine.

Eleven combine owners mentioned as an advantage that combines have the ability to separate the chaff from the straw, and five said that hired men prefer the combine to the stationary thresher.

The fact that the combine scatters the grain sacks was mentioned by 18 men and the scattering of weed seeds by 10 men. The packing of the soil, high repair cost, rough topography, first cost and depreciation, and mechanical trouble was mentioned by a relatively small number of combine owners. The larger combines are equipped with leveling devices which adapt them to fairly rough and uneven land. The difficulties due to rough topography were mentioned mainly by combine owners of the smaller machines which were not equipped with leveling devices.

Thus it is seen that these farmers were divided on a number of points concerning the advantages or disadvantages of the use of combines. These differences of opinions may have a number of causes, such as lay of land and extent of experience of operator regarding both methods of harvesting and threshing.

COST OF USING COMBINES

As in the case of tractor costs, the items of expense in the operation of motor-driven combines have been expressed, wherever possible, in terms of physical quantities. The figures showing the quantities and costs of fuel, lubricants, and days of repair work, as well as the other items of expense, are the average for the three-year period, 1920–1922, and represent the amounts used by the actual number reporting an expense for these items. Over the three-year period records were obtained from 32 owners of 9-foot combines; from 24 owners of 12 and 14 foot; from 24 owners of 16 and 18 foot; from 17 owners of 20 and 22 foot; and from 4 owners of 24-foot combines, or a total of 101 different motor-driven combines. Records were obtained on 52 of these combines for 3 years, on 29 for 2 years, and on 20 for 1 year, making, for the three-year period, a total of 234 reports on the cost of using combines.

Items here considered as a cost of operating motor-driven combines are fuel, oils and grease, repairs, insurance, depreciation, and interest. The yearly cost divided by the total number of 10-hour days the combine was used during the year gives the average cost of operation per 10-hour day.

FUEL, OILS, AND GREASE

The average quantities of fuel and cylinder oil used per year and per 10-hour day by combines of different sizes are given in Table 29.

TABLE 29.—*Fuel and cylinder oil requirements for combines of different sizes, 3-year average 1920–1922, 72 combines, 1920; 82 combines, 1921; 80 combines, 1922*

Size of combine (length of cutter bar)	Total reports	Gasoline			Distillate			Cylinder oil		
		Owners reporting	Quantity used per combine		Owners reporting	Quantity used per combine		Owners reporting	Quantity used per combine	
			Per year	Per 10-hour day		Per year	Per 10-hour day		Per year	Per 10-hour day
Feet	*Number*	*Number*	*Gallons.*	*Gallons.*	*Number*	*Gallons.*	*Gallons.*	*Number*	*Gallons.*	*Gallons.*
9	66	66	268	12	0	0	0	66	21	1.0
12 and 14	59	58	342	14	1	274	19	59	32	1.3
16 and 18	57	54	731	30	3	457	20	57	36	1.5
20 and 22	43	40	731	29	3	1,015	39	43	39	1.5
24	9	9	795	35	0	0	0	9	38	1.7
All sizes	234	227	500	21	7	670	29	234	31	1.3

No kerosene was used, and the use of distillate was reported only seven times. The fuel consumption per 10-hour day depends largely on the size of combine and the quantity of straw per acre. The consumption of gasoline per 10-hour day for 9-foot combines averaged 12 gallons. For 24-foot combines the daily requirement was approximately three times that quantity. The requirement of cylinder oil was closely related to size of combine. The average costs of fuel, oils, and grease per combine per year and per 10-hour day of use are shown in Table 30.

TABLE 30.—*Cost of fuel, oils, and grease for combines of different sizes, 3-year average, 1920–1922—72 combines, 1920; 82 combines, 1921; 80 combines, 1922*

Size of combine (length of cutter bar)	Average expense per combine							
	Gasoline		Distillate		Cylinder oil		Other oil and grease	
	Per year	Per 10-hr. day	Per year	Per 10-hr. day	Per year	Per 10-hr. day	Per year	Per 10-hr. day
Feet:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
9	78.33	3.63	0	0	20.47	0.95	4.14	0.19
12 and 14	106.66	4.13	60.00	4.11	26.76	1.08	6.07	.24
16 and 18	197.70	8.17	97.00	4.22	32.89	1.36	15.65	.65
20 and 22	211.85	8.48	226.00	8.69	38.53	1.53	16.05	.64
24	214.33	9.45	0	0	30.56	1.35	9.00	.40
All sizes	142.27	5.98	147.00	6.36	28.79	1.21	9.80	.41

CASH REPAIRS AND LABOR MAINTENANCE

Amount of time spent by the combine owner and other farm and expert labor in overhauling and in repair work at the farm, the expense for this labor, and the cash repairs (including the cash

outlay for new parts and skilled labor on the combine in machine shops off the farm) are shown in Table 31. Of the 234 records on the cost of operating motor-driven combines, labor spent by the owner was mentioned 179 times and other hired man labor 138 times. In general, the amount of time spent in repairing the combine increased with the size. Cash repairs were mentioned 223 times.

TABLE 31.—*Cost of cash repairs and labor maintenance of combines of different sizes, 3-year average, 1920–1922—72 combines, 1920; 82 combines, 1921; 80 combines, 1922*

Size of combine (length of cutter bar)	Total reports	Cash repairs		Owner's labor			Other labor		
		Owners reporting	Expense per combine per year	Owners reporting	Amount used per combine per year	Expense per combine per year	Owners reporting	Amount used per combine per year	Expense per combine per year
Feet:	*Number*	*Number*	*Dolls.*	*Number*	*Days*	*Dolls.*	*Number*	*Days*	*Dolls.*
9	66	66	132	52	7	27	34	8	39
12 and 14	59	54	147	42	7	27	36	9	43
16 and 18	57	55	288	44	10	41	36	12	67
20 and 22	43	39	298	34	13	56	27	15	74
24	9	9	324	7	9	72	5	7	63
All sizes	234	223	212	179	9	39	138	11	55

INSURANCE, DEPRECIATION, AND INTEREST

Insurance, depreciation, and interest charges for combines of different sizes are given in Table 32. Comparatively few owners of 9, 12, and 14-foot combines had insurance on their machines, but a majority of those with combines of the 16-foot and larger sizes had their combines insured.

TABLE 32.—*Cost of insurance, depreciation, and interest for combines of different sizes, 3-year average 1920–1922—72 combines, 1920; 82 combines, 1921; 80 combines, 1922*

Size of combine (length of cutter bar)	Total reports	Owners reporting insurance	Average expense per combine per year		
			Insurance	Depreciation	Interest
Feet:	*Number*	*Number*	*Dollars*	*Dollars*	*Dollars*
9	66	3	45	209	53
12 and 14	59	13	85	347	98
16 and 18	57	44	79	517	149
20 and 22	43	34	78	578	164
24	9	8	96	425	162
All sizes	234	102	80	395	112

Depreciation was computed from estimates of owners as to the value of combines at the beginning and end of the year. As might be expected, it was much higher on large than on small combines. It is an average for combines of different ages whether bought new or as used machines. In computing this charge no credit was allowed for the resale value of old combines.

An interest charge at the rate of 6 per cent was made against the average of the value of the combine at the beginning and end of the year.

The average first cost, years of useful life, and depreciation of combines of different sizes that were purchased new are given in Table 33. There was considerable variation in the estimated years of useful life of these combines, depending to a large extent upon the amount of work done and the care and attention they received. The data indicate that these owners can, on the average, expect the useful life of their combines to be from seven to eight years. The size did not seem to have much influence on the years of useful life. The first cost of combines of the same size varied considerably, depending upon the year in which they were bought.

TABLE 33.—*Average first cost, years of useful life, and depreciation of combines of different sizes, 74 combines, 1920–1922* [1]

Size of combine (length of cutter bar)	Combines	Average first cost	Useful life	Annual depreciation
Feet:	*Number*	*Dollars*	*Years*	*Dollars*
9	17	1,678	7.2	233
12 and 14	17	2,580	7.1	363
16 and 18	21	3,738	8.1	461
20 and 22	16	4,052	7.8	519
24	3	4,200	8.8	477

[1] Includes only those combines that were purchased new by the owners included in the survey and for which data were complete.

TOTAL COST OF USING COMBINES

Total cost of using combines per year and per 10-hour day during each of the three years 1920–1922 is given in Table 34. The costs for combines of the same size showed considerable variation, depending on the amount of work done, on differences in insurance, depreciation and repair charges, and on quantities of fuel and oil used.

TABLE 34.—*Cost per year and per 10-hour day of using combines of different sizes. 72 combines 1920; 82 combines 1921; 80 combines 1922*

Size of combine (length of cutter bar)	1920				1921				1922			
	Combines	Days of work per year	Cost		Combines	Days of work per year	Cost		Combines	Days of work per year	Cost	
			Per year of use	Per 10-hour day of use			Per year of use	Per 10-hour day of use			Per year of use	Per 10-hour day of use
Feet	*No.*	*Days*	*Dolls.*	*Dolls.*	*No.*	*Days*	*Dolls.*	*Dolls.*	*No.*	*Days*	*Dolls.*	*Dolls.*
9	23	19.0	529	27.84	22	23.8	571	24.01	21	22.1	521	23.52
12 and 14	15	28.0	788	28.14	22	23.5	811	34.50	22	23.8	741	31.08
16 and 18	17	25.7	1,421	55.29	21	24.2	1,268	52.38	19	22.6	1,313	58.13
20 and 22	14	25.9	1,477	57.03	14	25.1	1,538	61.27	15	24.5	1,323	54.00
24	3	29.5	1,472	49.90	3	19.2	1,450	75.52	3	19.3	1,106	57.31
All sizes	72	24.3	1,017	41.85	82	23.9	1,011	42.32	80	23.0	941	40.87

The cost per 10-hour day of use was considerably higher for large combines than for those of the smaller sizes, but the data as given in Table 37 shows that there was no significant difference in the cost per acre of using large and small sized combines.

In Table 35 an estimate is given of the 1923 and 1924 average cost of operating the combines found on these farms. The cost of fuel, oils, and grease is based on an average of the quantities used for the three-year period 1920–1922, charged at the prices which prevailed in 1923 and 1924. (See page 34.) The average amount of time spent by the owner and other labor in repair work on these machines over the period 1920 to 1922 was charged at the prices which prevailed for such labor in 1923 and 1924. The cash repairs, insurance, depreciation, and interest charges are the same as those that were used for the year 1922.

The cost per 10-hour day of use in 1923 and 1924 is based on the average of the days used over the period 1920 to 1922, inclusive.

TABLE 35.—*Estimated cost of using combines in 1923 and 1924 (Averages for combines of all sizes)*

Item	Quantity	Cost	
		1923	1924
		Dollars	*Dollars*
Fuel and oil:			
Gasoline—gallons	484	99	114
Distillate—do	21	4	4
Cylinder oil—do	31	26	26
Other oil—do	20	3	3
Hard grease—pounds	39	4	4
Repairs:			
Cash		193	193
Owner's labor—days	7	32	31
Other labor—do	6	34	33
Insurance		31	31
Depreciation		392	392
Total		818	831
Interest		98	98
Total cost per combine		916	929
Cost per 10-hour day of use (23.7 days per year)		38.65	39.20

EFFECT OF DAYS OF WORK AND ACRES CUT ON COST PER DAY AND PER ACRE OF USING COMBINES

The influence of the amount of work done on the cost of operating combines is shown in Table 36. The combines were grouped according to the number of days they were used annually, each group having its proportionate number of large and small sizes. The amount of work done increased with an increase in the days of annual use which resulted in lowered costs per acre of grain harvested. These combines were used an average of 23.7 days per year. The range in days of annual use was from 7.8 to 39.6.

TABLE 36.—*Effect of days of work and acres cut on cost per day and per acre of using combines, 61 combines, 1922*

Item	Annual days of work		
	Less than 20	20 to 30	30 and over
Combines—number	22	25	14
Tillable acreage per farm—acres	722	926	1,193
Acreage combined—do	416	555	688
Home work per combine—days	13.6	20.5	27.1
Custom work per combine—do	2.3	2.7	5.1
Partnership work per combine—do	.5	.6	0
All work per combine—do	16.4	23.8	32.2
Cost of using combine:			
Fuel—dollars	76.18	117.04	143.78
Oils and grease—do	28.63	35.40	33.64
Repairs—do	213.82	214.80	253.80
Insurance—do	25.73	29.96	34.64
Depreciation—do	345.32	383.12	360.00
Total—do	689.68	780.32	825.86
Interest—do	82.45	113.24	91.64
Total cost—do	772.13	893.56	917.50
Cost per 10-hour day of use—do	47.08	37.54	28.49
Cost per acre harvested—do	1.86	1.61	1.33

Forty-one per cent of these machines were used for custom work, and 6.6 per cent were owned in partnership. On the four farms where the combines were owned in partnership the days of annual use averaged 32.5 per cent greater than on farms of the same size

FIG. 10.—Harvesting and threshing wheat with a 16-foot cut tractor-drawn combine. Ninety-three per cent of the wheat acreage harvested with tractor-drawn combines was with machines of the 16-foot cut or larger sizes

where they were not owned in partnership. Although the amount of work done annually has a direct bearing on the cost per day or hour of use, it is not always convenient or desirable for some farmers to do custom work or to own a machine in partnership. This is a matter the individual must decide for himself, taking into consideration the local conditions with respect to acreages, cooperation, amount of home work, etc.

COST OF HARVESTING AND THRESHING WHEAT WHERE HORSE-DRAWN AND WHERE TRACTOR-DRAWN COMBINES WERE USED

The records have been grouped in Table 37 by size of combine to show the relative cost of combine harvesting and threshing where horses and where tractors were used. Over the three-year period, 1920–1922, 78.6 per cent of the total harvested wheat acreage was cut and threshed with motor-driven combines, 14.1 per cent with ground-power combines, and 7.3 per cent with headers and stationary threshers. Of the wheat acreage harvested with motor-driven combines approximately 60 per cent was with horse-drawn and 40 per

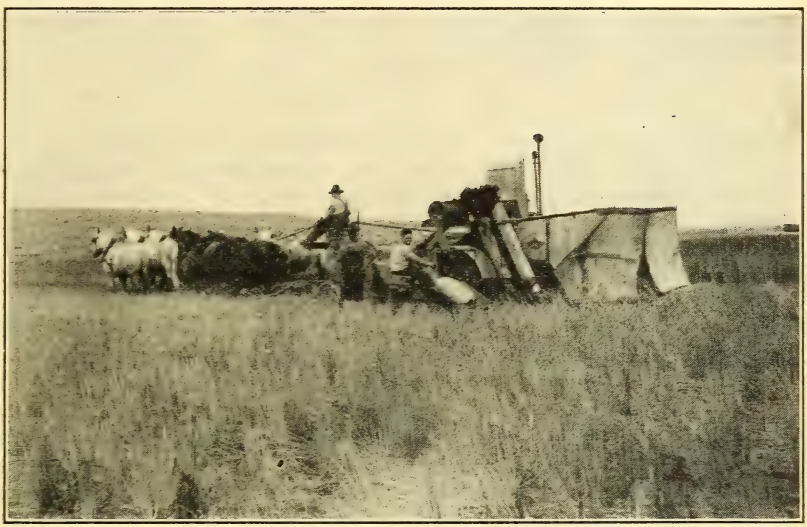

FIG. 11.—Harvesting and threshing wheat with a 9-foot cut horse-drawn combine. Of the wheat acreage cut with horse-drawn combines 64.2 per cent was with combines of 14-foot cut, or smaller sizes

cent with tractor-drawn combines. The horse-drawn machines were mainly of the 14-foot and smaller sizes, whereas most of the tractor-drawn machines were of the 16 to 22 foot sizes. (Figs. 10 and 11.)

TABLE 37.—*Cost of harvesting and threshing wheat where horse-drawn and where tractor-drawn combines were used, 3-year average, 1920–22*

HARVESTED AND THRESHED WITH HORSE-DRAWN COMBINES

Size of combine (length of cutter bar)	Reports	Acreage cut	Percentage of total	Average acres cut per day	Average crew		Hours and cost per acre						Total cost per acre
							Man labor		Horse work		Use of combine		
					Men	Horse	Hours	Cost	Hours	Cost	Hours	Cost	
Feet	*No.*	*Acres*	*P. ct.*	*Acres*	*No.*	*No.*	*No.*	*Dolls.*	*No.*	*Dolls.*	*No.*	*Dolls.*	*Dolls.*
9	58	15,203	17.2	13.6	2.2	8.4	1.6	0.91	6.1	0.73	0.7	1.77	3.41
12 and 14	52	18,591	21.1	18.9	3.0	12.1	1.5	.89	6.3	.62	.5	1.71	3.22
16 and 18	17	5,754	6.5	32.2	5.1	24.4	1.6	.90	7.2	.77	.3	1.93	3.60
20 and 22	25	13,053	14.8	35.3	5.4	27.6	1.6	1.01	8.1	.81	.3	1.69	3.51

TABLE 37.—*Cost of harvesting and threshing wheat where horse-drawn and where tractor-drawn combines were used, 3-year average, 1920–22*—Contd.

HARVESTED AND THRESHED WITH TRACTOR-DRAWN COMBINES

Size of combine (length of cutter bar)	Reports	Acreage cut	Percentage of total acres	Average acres cut per day	Average crew, men	Hours and cost per acre						Total cost per acre
						Man labor		Use of tractor		Use of combine		
						Hours	Cost	Hours	Cost	Hours	Cost	
Feet	*No.*	*Acres*	*P. ct.*	*Acres*	*No.*	*No.*	*Dolls.*	*No.*	*Dolls.*	*No.*	*Dolls.*	*Dolls.*
9	4	1,248	1.4	20.7	3.2	1.8	1.12	0.6	1.35	0.6	1.35	3.82
12 and 14	2	1,343	1.5	22.3	3.0	1.3	1.07	.4	1.09	.4	1.16	3.32
16 and 18	32	20,157	22.8	32.6	5.4	1.7	1.15	.3	1.35	.3	1.77	4.27
20 and 22	14	8,142	9.2	38.0	5.6	1.5	.97	.3	1.22	.3	1.55	3.74
24	7	4,810	5.5	39.3	6.0	1.6	1.01	.3	1.22	.3	1.68	3.91

Acreage cut per 10-hour day by combines of the same size was larger for tractor than for horse-drawn machines. The number of horses displaced by the tractor ranged from an average of about 8 for the 9-foot combine to an average of about 28 for the 20 and 22 foot combines. A slightly larger crew, together with slightly higher wages, usually resulted in a higher man-labor cost per acre for tractor-drawn combines than for horse-drawn machines of the same size. The average per-acre cost for use of horses was considerably less than the cost for use of the tractor to draw the combine.

On the other hand, the per-acre-use cost of the combine was somewhat higher for horse than for tractor drawn machines. This is because the harvested acreage of grain on farms where tractor-drawn combines were used was larger than on farms where horses were used. The average grain acreage (including wheat, barley, oats, and custom work) per combine on farms where tractor-drawn combines were used was 802, as against an average of 455 acres per combine on farms where horse-drawn combines were used. Likewise, tractor-drawn combines were used an average of 26 days per farm, as compared with 22 days per farm for horse-drawn combines.

COMPARATIVE COST OF HARVESTING AND MARKETING BULKED AND SACKED WHEAT WHEN CUT WITH COMBINES DRAWN BY TRACTORS

The comparative requirements and costs of harvesting and marketing bulked and sacked wheat, where cut with tractor-drawn combines, are given in Table 38. Formerly all wheat produced in Sherman County was sacked and hauled to warehouses, but during recent years a few elevators have been established and a few men have started to bulk their wheat. To compare the relative economy of harvesting and marketing bulked and sacked wheat, farms were selected representing the two methods where the other factors influencing costs, such as acres of wheat harvested per farm, yield per acre, and average distance hauled, were fairly comparable.

TABLE 38.—*Comparative cost of harvesting and marketing bulked and sacked wheat when cut with tractor-drawn combines, 1922*

Item	Bulked wheat		Sacked wheat		Amounts not canceled
	Amount	Cost	Amount	Cost	
		Dollars		*Dollars*	
Number of farms	4		5		
Acres in wheat per farm	600		531		
Yield per acre (bushels)	20.1		20.1		
Acres cut per 10-hour day	35.0		35.5		
Harvesting:					
Crew, men	4		6		2 men.
Man-hours per acre	1.13	0.81	1.69	1.18	$0.37
Combine-hours of use per acre	.28		.28		None.
Tractor-hours of use per acre	.28		.28		None.
Sacks and twine			8.7	.93	$0.93
Additional cost of sacked wheat over bulked wheat:					
Per acre					$1.30
Per bushel					$0.065
Marketing:					
Average distance hauled (miles)	2.6		2.6		
Bushels hauled per 10-hour day	700		700		
Average crew—					
Men	2.75		2.30		
Horses	9.83		10.04		
Man-hours per acre	.79	.43	.66	.36	−$0.07
Horse hours per acre	2.82	.40	2.87	.41	$0.01
Grain wagons—hours of use per acre	.79	.06	.73	.06	None.
Total additional cost of sacked wheat over bulked wheat:					
Per acre					$1.24
Per bushel					0.062
Value of product—					
Per acre		18.99		20.10	$1.11
Per bushel		.945		1.00	0.055
Difference in favor of bulked wheat:					
Per acre					$.13
Per bushel					[1].006

[1] Only a very slight net saving is shown where wheat was bulked but the greater quantity of wheat wasted when sacked should be taken into consideration. This loss occurs while the bags are being sewed, through damage to the bags in the field by mice and loss through torn and leaky bags during handling and hauling to the warehouse.

Standard crew sizes were set up for the harvesting, but this could not be done for the marketing work, because there were not enough men who hauled the same distance with the same size of crew. For each group the same average man and horse cost rate was used for all man labor and horse work performed in marketing. The man-labor costs for harvesting reflect the actual wages paid the harvesting crews in each group. There was a saving in the harvesting crew of two men where the wheat was bulked, since by this method no sewers or sack jiggers were required. This, together with a charge per acre of $0.93 for grain sacks, made an additional cost for harvesting of sacked wheat over bulked wheat of $1.30 per acre. (Fig. 12.) The cost of marketing wheat, however, was $0.06 per acre greater for bulked than for sacked wheat, resulting in a total additional cost of sacked wheat over bulked wheat of $1.24 per acre. Sacked wheat commanded a slightly better price on the farm, so that, considering the greater sale value of sacked wheat, there was a net difference in favor of bulked wheat of only $0.13 per acre. This difference is slight, but the greater quantity of wheat wasted when

sacked should be taken into consideration. This loss occurs while the bags are being sewed, through damage to the bags in the field by mice, and through torn and leaky bags during handling and hauling to the warehouse.

COMPARATIVE COST OF HARVESTING, THRESHING, AND MARKETING WHEAT WHERE COMBINES AND WHERE HEADERS AND STATIONARY THRESHERS WERE USED

In Table 39 is shown the comparative cost of harvesting, threshing, and marketing wheat where small combines and where headers and stationary threshers were used. Table 40 shows the same comparison where large combines were used. In making these comparisons standard requirements in numbers of men and horses have been set up wherever possible. The same horse rate for all horse

FIG. 12.—Harvesting and threshing bulked wheat with a 16-foot cut tractor-drawn combine. Only a limited amount of grain was handled in bulk. Wheat harvested in this manner showed a slightly lower cost per bushel than when sacked

work and the same man-labor rate for marketing was used for each group. The man-labor cost for harvesting with a combine and with a header and stationary thresher reflect the actual wages paid for this work.

With a small combine 7 less men were used and 2.13 less man hours per acre were required than when a header and stationary thresher was used. Where a large combine was used there was a saving of 3 men and 1.83 man hours per acre. The small combine used 4 less horses, but the large combine required 15 more than the header and stationary thresher. The number of horse hours per acre was greater for both the large and small combine than for the header and stationary thresher. The stationary thresher showed a total additional cost over the small combine of 95 cents per acre and over the large combine an additional cost of 26 cents per acre.

TABLE 39.—*Comparative cost of harvesting, threshing, and marketing wheat where small combines and where headers and stationary threshers were used, 1922* [1]

Item	Combine		Header and stationary thresher		Amounts not canceled
	Amount	Cost	Amount	Cost	
		Dolls.		*Dolls.*	
Number of farms	6		5		
Acres in wheat per farm	284		285		
Yield per acre (bushels)	15.3		15.3		
Acres cut per 10-hour day	14.1		25.3		
Harvesting and threshing:					
Cutting with header—					
Crew—					
Men			1		
Horses			6		
Man hours per acre			.39	0.24	
Horse hours per acre			2.37	.24	
Hauling to thresher—					
Crew—					
Men			4		
Horses			6		
Man hours per acre			1.58	.71	
Horse hours per acre			2.37	.24	
Threshing—					
Crew, men			4		
Man hours per acre			1.58	.94	
Total harvesting and threshing—					
Crew—					
Men	2		9		[2]
Horses	8		12		[3]
Man hours per acre	1.42	.82	3.55	1.89	$1.07
Horse hours per acre	5.67	.57	4.73	.48	−.09
Stationary thresher and combine, hours of use per acre	.71	1.46	.39	1.37	−.09
Header, hours of use per acre			.39	.24	.24
Wagons and racks, hours of use per acre			1.18	.10	.10
Sacks and twine per acre	7.1	.71	7.1	.71	None.
Additional cost of stationary threshing over the combine method—					
Per acre					$1.23
Per bushel					.08
Marketing:					
Average distance hauled (miles)	4.4		4.4		
Bushels hauled per 10-hour day	365		365		
Average crew—					
Men	1.90		1.22		
Horses	9.11		6.44		
Man hours per acre	.80	.43	.51	.28	$−.15
Horse hours per acre	3.83	.39	2.70	.28	−.11
Grain wagons, hours of use per acre	1.01	.08	.78	.06	−.02
Total additional cost of stationary threshed wheat over the combine method—					
Per acre					$.95
Per bushel					.062

[1] Based on 9-foot cutter bar combines. [2] Seven men [3] Four horses.

TABLE 40.—*Comparative cost of harvesting, threshing, and marketing wheat where large combines and where headers and stationary threshers were used, 1922* [1]

Item	Combine		Header and stationary thresher		Amounts not canceled
	Amount	Cost	Amount	Cost	
		Dolls.		*Dolls.*	
Number of farms	6		5		
Acres in wheat per farm	419		285		
Yield per acre (bushels)	19.9		19.9		
Acres cut per 10-hour day	34.8		25.3		
Harvesting and threshing:					
Cutting with header—					
Crew—					
Men			1		
Horses			6		
Man hours per acre			.39	.24	
Horse hour per acre			2.37	.24	
Hauling to thresher—					
Men			4		
Horses			6		
Man hours per acre			1.58	.71	
Horse hours per acre			2.37	.24	
Threshing—					
Crew, men			4		
Man hours per acre			1.58	.94	
Total harvesting and threshing—					
Crew—					
Men	6		9		[2]
Horses	27		12		[3]
Man hours per acre	1.72	1.13	3.55	1.89	$0.76
Horse hours per acre	7.76	.80	4.73	.48	−.32
Stationary thresher and combine hours of use per acre	.29	1.51	.39	1.37	−.14
Headers, hours of use per acre			.39	.24	.24
Wagons, hours of use per acre			1.18	.10	.10
Sacks and twine per acre	8.7	.87	8.7	.87	None.
Additional cost of stationary thresher over the combine method—					
Per acre					$0.64
Per bushel					.032
Marketing:					
Average distance hauled (miles)	4.4		4.4		
Bushels hauled per 10-hour day	365		365		
Average crew—					
Men	1.90		1.22		
Horses	9.11		6.44		
Man hours per acre	1.04	.56	.67	.36	$−.20
Horse hours per acre	4.99	.51	3.54	.36	−.15
Grain wagons, hours of use per acre	1.33	.11	1.02	.08	−.03
Total additional cost of stationary threshed wheat over the combine method—					
Per acre					$.26
Per bushel					.013

[1] Based on 20-foot cutter-bar combines. [2] 3 men. [3] 15 horses.

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